IMPLEMENTATION PLAN FOR
LOT 8 GROUNDWATER REMEDIATION
WELL INSTALLATION PROGRAM
FORMER BOEING C-6 SITE
LOS ANGELES, CALIFORNIA

Prepared for

Boeing Realty Corporation
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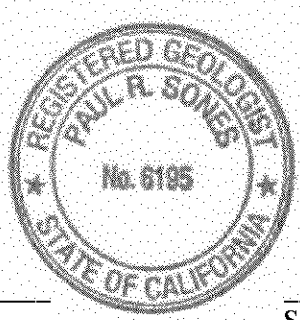

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1. INTRODUCTION

Boeing Realty Corporation (BRC) has investigated the groundwater at the Former C-6 facility (Site) located in Los Angeles, California (Figure 1). Investigations have shown the presence of volatile organic compounds (VOCs) in groundwater in certain areas of Lot 8, located in the northern area of Parcel C of the Site. To facilitate groundwater remediation, injection of amendment solution into the impacted groundwater was selected to promote In-Situ bioremediation of the VOCs.

This Implementation Plan details the installation of the amendment well system that consists of 166 amendment wells (AWs) and six groundwater monitoring wells (MWs) at the Site. The well installation data for the AWs and MWs are presented in Table I. The system is to be installed in Lot 8 of Parcel C and Parcel A in the northern portion of the former Building 1/36 area. The AWs and groundwater MWs locations are shown on Figure 2.

The number and location of the 166 AWs is included in a work plan entitled, *Building 1/36 Area (Parcel C) Source-Area Groundwater In-Situ Reactive Zone Pilot Study Workplan* dated 10 May 2002 was prepared by Arcadis G&M, Inc. (Arcadis) and submitted to the California Regional Water Quality Control Board - Los Angeles Region (LARWQCB). This work plan was approved by the LARWQCB in a letter dated 29 October 2002. The Site description, geology and hydrogeology are described in that work plan.

1.1 Purpose

The purpose of this Implementation Plan is to provide a concise technical plan, decision criteria and standard operating procedures (SOPs) to be used during the installation of the AWs and MWs in the B-Sand and C-Sand at the Site.

1.2 Remediation Design Concept

The purpose of the AWs is to provide a mechanism to deliver carbohydrate solution to target groundwater impacted with VOCs in the B-Sand and C-Sand water bearing units. A total of 110 B-Sand and 56 C-Sand AWs will be installed. In addition, six MWs (two in the B-Sand and four in the C-Sand) will be installed. The amendment solution will be injected into each AW to create a reactive zone at, and down gradient from, each well. The purpose of the MWs is to monitor the baseline, process and performance of the remediation in the reactive zone.

To further define the subsurface lithology in the amendment injection area, a geologic reconnaissance drilling and AW installation program will be performed. Following this geologic reconnaissance program, the designs of the remaining AWs and the six MWs will be refined. This geologic reconnaissance program is described in Section 2. The Well Construction Plan for the AW and MW construction are presented in Section 3. The Well Development and Testing Plan to be used is presented in Section 4. The connection of the AWs to the subsurface manifold piping is described in Section 5.

1.3 Installation Schedule

The AW and MW installation schedule is tied to the development plans for the Site. The 166 planned AWs and six MWs will be installed over five phases of work. The well installation schedule for the five phases of work is presented in Table II and described below:

Phase I

Phase I will consist of installing 18 AWs (8 B-Sand wells to 85 ft and 10 C-Sand wells to 115 ft) at selected locations on the site for geologic reconnaissance purposes (Figure 2). Each of these 18 reconnaissance wells will be continuously cored with 5 ft long split-spoon samplers from depths of 50 feet to total depth (i.e., 85 ft for the B-sand Wells and 115 ft for the C-Sand wells). These 18 AWs will be completed in the same manner described in Section 3. It is anticipated that the driller will provide two hollow stem auger (HSA) drill rigs for the installation of these 18 reconnaissance injection wells. The Phase I well installation program is scheduled to begin on 16 August 2004 and be completed (including well development) by 3 September 2004.

Phase II

Phase II will consist of installing approximately 16 AWs (2 B-Sand wells to 85 ft and 14 C-Sand wells to 115 ft) on Parcel A of the Site (Figure 2). No soil sample collection will be performed during drilling and installation of these 17 AWs. Phase II is tentatively scheduled to begin in late September 2004.

Phase III

Phase III will consist of installing approximately 37 B-Sand AWs to 85 ft in the area of a planned building pad (Figure 2). No soil sample collection will be performed during drilling and installation of these 40 AWs. Phase III is tentatively scheduled to begin in November or December 2004 and multiple drilling rigs will be used.

Phase IV

Phase IV will consist of installing the remaining 95 AWs (63 B-Sand wells to 85 ft and 32 C-Sand wells to 115 ft) in the open areas of the Site following construction of a planned commercial building (Figure 2). No soil samples will be collected during installation of these 81 AWs. Phase IV is tentatively scheduled to begin in January or February of 2005 and multiple drilling rigs will be used.

Phase V

Phase V will consist of installing the six MWs (2 in the B-Sand to 85 ft bgs and 4 in the C-Sand to 115 ft bgs) in the remaining open areas of the Site following construction of a commercial building (Figure 2). Soil samples will be collected at 5 ft intervals during drilling of these six MWs for lithologic logging. Phase V is tentatively scheduled to begin in March of 2005 and multiple drilling rigs may be used.

2. GEOLOGIC RECONNAISSANCE DRILLING

During previous investigations of the Site, several groundwater monitoring wells, direct-push soil and groundwater grab samples, and two Cone Penetrometer Testing (CPT) points have been installed in the Parcel C Area. Geologic cross-sections developed from these assessment activities have been reviewed to prepare the preliminary design and placement of the AWs. To fill data gaps and to confirm the lithology in the B-Sand and C-Sand water bearing units, 18 of the proposed AWs have been selected for installation during a Phase I geologic reconnaissance program. The 18 AWs selected for geologic reconnaissance are shown on Figure 2. During drilling, each of these 18 reconnaissance AWs will be continuously cored from 50 ft bgs to the total depth of the well (i.e., approximately 85 ft bgs for the B-Sand AWs and 115 ft bgs for the C-Sand AWs

2.1 Drilling and Logging Methods

Each geologic reconnaissance AW will be drilled with a HSA drill rig using 8-inch outside diameter augers. During drilling, continuous cores will be collected in 5 ft segments using a 5 ft long split-spoon sampler equipped with a sand capture device, but with no internal sample rings. The split-spoon sampler will be used such that it is advanced into the formation ahead of the tip of the augers. Every 5 ft the sampler will be removed from the boring and opened. The geologist will record the percentage of core recovery contained within the sampler on the boring log. The core will then be placed on plastic sheet and the ends of the core labeled with the corresponding depth in the order that they are recovered from the boring. The core will be geologically logged by the geologist following the Unified Soil Classification System (USCS). Digital photographs of each continuous core will also be taken. A copy of the Geologic Boring Log to be used is included with the field forms in Appendix A. The continuous core geologic descriptions will conform to the Boeing Data Management Plan (DMP) (CH2MHill, 2002). Field forms for geologic logging of these reconnaissance wells are included in Appendix A.

To assess the percentage of fines in the formation material from the target water bearing units, sediment samples will be collected from the B-Sand and C-Sand cores collected for sieve analysis. Approximately six representative soil samples will be collected from each target unit. Because these samples will be used only for sieve analysis, it is not necessary for them to be undisturbed samples and they can therefore be collected directly from the continuous cores. The collected samples will consist of approximately 2 pounds of soil and will be placed in labeled self-sealing plastic bags for transportation to the geotechnical laboratory. The sample labeling procedures are presented in Appendix B. The results of the sieve analyses will be used to refine the screen slot size and filter pack specification for the AWs and MWs to be installed during subsequent phases of the well installation program.

2.2 Reconnaissance Injection Well Installation

The lithology of each boring will be used to identify the B-Sand and C-Sand water bearing units and selection of the appropriate screen interval for each of the AW. The screened intervals will be placed to intercept the more permeable sand of the VOC-impacted water bearing units. The well installation will follow the steps identified in the Injection Well

Construction Plan Flow Chart (Figure 3). Well construction details are presented in the Well Construction Plan in Section 3 and Appendix C of this Implementation Plan. Following installation, the wells will be developed following the methods described in the Well Development and Testing Plan in Section 4 and Appendix D of this Implementation Plan. Following development, the tops of these AWs installed within the future footprint of the proposed building will be cutoff a minimum of 3 ft below grade, capped, and backfilled with sand to grade for protection during future grading operations. The cut and cap depth will be verified with the geotechnical and grading contractors prior to implementation. The surveyed coordinates of each of the reconnaissance injection wells will be used to locate and expose these wells following grading. The AWs installed outside of the future building pad will be left with a 2 ft stickup above grade and marked with wood stakes or steel re-bar, and flagging to protect them during future grading operations. Once the planned building pad is completed and certified, the AWs will be re-exposed and connected to the piping manifold as described in the Injection Well Connection section of this Implementation Plan (Section 5).

2.3 Review of Reconnaissance Data

Following installation of the 18 reconnaissance AWs, the boring logs, along with logs from previous subsurface assessment borings and CPT points in the Lot 8 area, will be reviewed and cross-sections generated to identify the depths of the boundaries of the B-Sand and C-Sand VOC-impacted water bearing units in the remediation area. The cross-sections will allow for confirmation or revision of the screened intervals for the remaining 100 B-Sand and 48 C-Sand injection wells, and three B-Sand, and four C-Sand monitoring wells.

3. WELL CONSTRUCTION PLAN

This section has been prepared to identify the major components of AW and MW construction within the Well Implementation Plan. The detailed specifics of well construction are included in the Well Construction SOP located in Appendix C.

A total of 166 amendment injection wells and six groundwater monitoring wells will be installed in the Lot 8 area of Parcel C at the Site (Figure 2). The pre-mobilization activities, description of the AWs and MWs, waste handling procedures, Quality Assurance/Quality Control (QA/QC) measures to be used, and health and safety procedures are described below.

3.1 Pre-mobilization Activities

Prior to mobilization to the Site for the well installation program, the following steps shall be performed.

- Review SOPs for well construction, and development and testing (Appendices B and C), and then revise these SOPs (if necessary) using the results from the geologic reconnaissance well installation (Phase I).
- Review and update the Site-specific Health and Safety Plan for well installation oversight for each phase of work.
- Obtain well installation permits from the Los Angeles County Department of Health Services.
- Complete Boeing Pre-field Checklist one-week prior to mobilization for each phase of work.
- Coordinate project construction schedules with BRC and Cypress Equities for each phase of work.
- Coordinate waste storage containers, profiling and disposal with Boeing Waste Management Specialist a minimum of 2-weeks in advance of field work.
- Confirm and coordinate access to Site following provisions of Access Agreement with Cypress Equities and notify in writing 2 weeks in advance of drilling for each phase of work.
- Confirm physical access to all proposed drilling locations prior to each phase.
- Notify LARWQCB of work phase start.
- Notify all parties of start of each phase of work.
- Conduct pre-field kick-off meeting with Project Team.
- Conduct on-Site Kick-off meeting on the first mobilization day of each phase of work.

3.2 Description of Injection and Groundwater Monitoring Wells

Installation of the injection wells will follow the Injection Well Construction Plan Flow Chart (Figure 3). The locations of the AWs and MWs are shown on Figure 2. Typical well construction diagrams for the AWs and the MWs are shown on Figures 4 and 5, respectively. The number, type and well construction to be used are described below.

- A total of 110 Upper B-Sand AWs to 85 ft bgs will be installed.
- A total of 56 C-Sand AWs to 115 ft bgs will be installed.
- A total of six MWs will be installed (2 in B-Sand to 85 ft bgs and 4 in C-Sand to 115 ft bgs).
- The AWs and MWs will be installed at the Site in five phases of work described in Section 1.4.
- All down-hole drilling equipment and augers will be decontaminated between each injection well by pressure washing and steam cleaning at a centrally located, plastic sheet lined and contained decon pad to be constructed by the driller. Decon water will be collected and transferred to the liquid waste holding tank(s). Soil sediment will be separated and transferred to the drill cuttings roll-off bins or drums. At the end of each phase of the well installation program, the decon pad will be washed, removed and disposed of properly by the driller.
- All AW locations in Parcel A (eastern area) of the Site will be cleared for underground utilities by a geophysical locator contractor during Phase I and II of the well installation program. In addition, it is necessary to hand auger to 5 ft bgs at three locations in a triangular pattern at the 18 injection well locations in the Parcel A area. Hand augering at the remaining 148 AW locations in other areas of the Site may not be necessary, but may be required along Knox Street. Because the six groundwater monitoring wells will be installed following development of the Site, these well will be hand augered to a depth of 10 ft bgs in a triangular pattern prior to their installation during Phase V of the well installation program.
- All AW and MWs will be drilled with 8-inch outside diameter by 5 ft long hollow stem augers.
- The AWs will be constructed with 2-inch diameter Schedule 40 PVC casing and screens with 0.020-inch machine cut slots.
- The MWs will be constructed with 2-inch diameter Schedule 40 PVC casing and screens with 0.010-inch machine cut slots.
- The length of the screened interval will typically be 20 ft, however, based on the results of the geologic reconnaissance well installation program (Section 2.0), the depth and lengths of well screens in the AWs and MWs may be revised.
- The filter pack material to be used for the injection wells will be No. 3 Monterey sand, or equivalent. The filter pack material to be used for the groundwater monitoring wells will be No. 2/12 sand, or equivalent. The AW and MW filter pack specification may be revised based on the results of the sieve analyses performed on soil samples collected during the Phase I geologic reconnaissance program. Placement of the filter pack will follow the procedures described in the Well Construction SOP

included as Appendix C.

- The bentonite seal is to consist of 5 ft of ¼-inch WYO-BEN pellets placed in 12-inch maximum lifts. The method of placement and hydration of the bentonite seal is described in the Well Construction SOP included as Appendix B. The thickness, hydration, and placement of the bentonite seal are critical to seal-off adjacent water bearing zones and facilitate injection into the target VOC-impacted water bearing units.
- The remaining annular seal will consist of a Portland cement grout with approximately 4 percent bentonite powder added by weight. The mixture and procedure for placement of the annular seal is described in Appendix B.
- As the filter pack, bentonite seal and cement/bentonite grout are placed, the augers can be withdrawn. However, to prevent the formation material from caving around the well screen and casing, at no time shall the base of the augers be allowed to rise above the top of the placed filter pack, bentonite seal or grout level. The grout seal will be placed to within 3 ft of grade.
- For AWs installed outside of the pad for the planned building, a minimum of 2 ft of stickup of the well casing will remain above grade. The well will be capped with a PVC slip cap and marked with wooden stakes and flagging. AWs located within the future building pad will be cutoff a minimum of 3 ft bgs, capped and the boring backfilled to grade with sand to protect the wells during future grading activities.
- The level of the grout seal in each well will be periodically inspected for one week following installation to observe any settling of the grout. If settlement is observed, additional grout will be mixed and added to bring it within 3 ft of grade. Any soil which caves into the borehole will be removed prior to placement of additional grout.
- The surface completion of the six monitoring wells will be a 12-inch diameter traffic rated well box set in concrete. The top level of the well box will be raised approximately ½-inch above the pavement level to promote drainage away from the box.

3.3 Waste Handling

Storage and disposal of the investigation derived wastes (IDW) generated during the well installation program will be coordinated with the Boeing Waste Management Specialist Ms. Marcia Taleff a minimum of 2-weeks prior to mobilization for each phase of the program.

Soil cuttings will be placed in roll-off bins to be located in a designated waste handling area on the Site. The driller will transport the cuttings from the well location to the roll-off bins using a soil hopper and a forklift.

Well purge water and decontamination rinse water will be placed in a 6,000 gallon holding tank located in a designated waste handling area on the Site. The driller will be responsible for pumping all decon rinse water and well development water into the holding tank.

All well construction debris and trash will be collected and disposed of daily by the driller.

All IDW containers will be labeled with an adhesive waterproof label and waterproof marker and catalogued on a daily basis. Each container label will contain the following information:

- Client (generator) identification (name and address);
- Name and phone number of Boeing Waste Management Specialist;
- Date(s) generated;
- Container Contents (example: well cuttings from well AW-112, development purge water from wells AW-97 and AW-98, etc);
- Estimated volume or capacity; and
- Physical state of material (solid or liquid)

The Field Coordinator will be responsible for maintaining a compiled list of all of the IDW containers generated on a daily basis. A waste inventory form is included in Appendix A. This list is to be provided to the Boeing Waste Management Specialist every Friday during the drilling program.

3.4 QA/QC Measures

To ensure the AW installation program meets the goals required for the successful remediation of the Site, the following Quality Assurance/Quality Control (QA/QC) measures have been developed.

- Development of a Project Team Organization with clear designated responsibilities regarding QA/QC during the well installation program.
- Developing Standard Operating Procedures (SOPs) to be followed during field activities (Appendices B and C).
- Identifying QA/QC Procedures to ensure SOPs are followed and documented.

The QA/QC measures are presented in Appendix B.

4. WELL DEVELOPMENT AND TESTING

Following installation, all of the injection and groundwater monitoring wells will be developed to remove sediment from the well casing and increase hydraulic communication with the water bearing formation. The well development will follow the Injection Well Construction Plan Flow Chart (Figure 3). The main steps of the well development and testing program are described below.

4.1 Well Development

Installed wells will be developed a minimum of 72-hours following installation. Well development procedures to be used are described in detail in Appendix C. Development will consist of:

- Wait a minimum of 72 hours following placement of the annular grout seal to allow seal to set;
- Surging the well screen of each well using a 2-inch diameter vented surge block for a minimum of 1 minute for each linear foot of screen (i.e., 20 minutes each for the B-Sand and C-Sand AWs and MWs);
- Bailing the wells to remove sediment to a point where the wells can be pumped; and
- Pumping the wells at increasing rates for approximately 1-hour until the extracted groundwater has turbidity below 10 NTUs, suspended sediment load of less than ¼-inch in a 1-liter Imhoff Cone, and water quality parameters stabilize to within 10 percent of previous readings.
- During the pumping phase of development, a level monitoring pressure transducer will be placed in the well to monitor the pumping and recharge water levels within the well. The pressure transducer will be monitored at the surface by the oversight geologist and the data will also be downloaded to a computer file and stored for future analysis.
- Following shutoff of the pump, the pump and pressure transducer will remain in the well until 80 percent of total static water level recovery is achieved or ½-hour, which ever is shorter.

4.2 Injection Well Testing

If a well displays slow recharge capability and does not recover to within 80 percent of static levels within ½-hour following pump shutoff, a water injection test will be performed to assess if the well will siphon water from a surface holding tank. The water injection testing procedures are described in detail in Appendix C. The test will consist of:

- Injecting potable water into the well at increasing flow rates and monitoring the water level within the well using a pressure transducer.

- The duration of the injection test will not exceed 2 hours and will be directed by the oversight geologist/engineer.
- If water or grout is observed to rise to the surface during the test, it will be concluded that the well seal can not hold the pressure and the well can not be used for injection purposes.
- If a well fails the injection pressure test, or if other observations indicate that the well has not been installed according to the well construction SOP (e.g., filter pack in the well, sediment in well can not be removed by development process, etc.), it will be abandoned by the methods described in the Well Construction SOP (Appendix C) and reinstalled following the well construction SOP. The replacement well will be installed approximately 10 feet away from the abandoned well and the new well re-tested according the Injection Well Construction Plan Flow Chart (Figure 3).
- If it is believed that geologic factors may be responsible for failure of the AW, the boring for the replacement well may be sampled at 5 ft intervals using a split-spoon sampler and the boring geologically logged. The boring log will be used to identify the placement of the screen interval for the replacement well.

5. CONNECTION SPECIFICATION & QA/QA

The connection of the bioamendment wells to the piping system is a critical component in the integrity of the bioremediation system and requires special attention to the construction methods used. This specification, along with Detail A, Sheet C-5 included in the system design provides the piping contractor with the requirements of this connection. Further, QA/QC measures are also provided for the piping contractor (PC) to be aware of and the construction manager (CM) to use to verify the work has been done in accordance with the specification.

5.1 Well Connection Specification:

The primary specifications for the connection of the bioamendment wells to the system piping are contained in the system design with specifications located on the plans. The following are provided primarily for the CM to verify PC compliance with the plans.

- Verify well name.
- Trench pipeline to well head per plans-preventing soil cave-in into well annular space and maintaining proper slope to wells.
- Extend pipeline to wellhead including transition fitting and dry-fit to ensure well and piping are not under stress per plans.
- Pressure test pipeline including transition fitting per plans.
- Install required PVC reducer and coupling fittings on well using solvent welding techniques per plan and PVC manufacturer's specification.
- Connect transition fitting (in vertical) to well per plan and manufacturer's specifications.
- Survey well head locations and elevations to Site grid.
- Remove all sediment from the top of the well annular grout seal and thoroughly wet prior to slurry placement.
- Backfill well annular space and pipeline with cement slurry per plan in a single monolithic pour, starting with the well and working up to the pipeline. Care shall be taken to prevent borehole/trench cave-in during slurry placement.

5.2 QA/QC Measures

- CM to review specification with PC prior to piping work commences to ensure understanding.
- CM to verify all materials specified in the design are being used by the PC. No material substitutions will be allowed.
- CM to visually inspect and measure the top of the well annular grout seal prior to excavation for piping.
- CM to verify well and piping names/numbers match.

- CM to inspect PVC reducer and coupling joints for proper prime and solvent welding. No fitting separation shall be present or the fittings will be removed and re-installed.
- CM to inspect lateral line to well and connections to verify the piping has been pressure tested and flushed per the system design and plans to the well connection and is properly bedded in the trench.
- CM to verify the use of the Poly-Cam PVC-HDPE transition fitting in the vertical axis.
- CM to verify a dry fit of the transition fitting creates no stresses on the well or lateral pipeline.
- CM to photograph well to piping completion prior to backfilling.
- CM to verify well head is surveyed by Project Surveyor prior to backfilling.
- Prior to slurry backfilling, CM to verify top of well grout seal is free of all soil and sediment debris so that the slurry bonds with the well grout seal.
- CM to verify top of grout seal is wetted with water prior to slurry placement and that slurry is carefully placed to prevent borehole cave-in.
- CM to verify cement slurry mix and compliance with plans.
- CM to mark as-built drawings regarding the completion daily.

5.3 Documentation

- CM to record all materials used in construction in Field Log Book.
- CM to record all QA/QC observations made in Field Log Book.
- CM to photograph each well connection and store electronically in project CM file.
- Project surveyor to record well coordinates and provide to CM for as-built drawings.

REFERENCES

1. Arcadis, 2002, *Building 1/36 Area (Parcel C) Source-Area Groundwater In Situ Reactive Zone Pilot Study Workplan, Boeing Realty Corporation, Former C-6 Facility, Los Angeles, California*. 10 May.

2. CH2MHill, 2002, *Data Management Plan (Revision 04), Prepared for the Boeing Company*. January.

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TABLES

Table I
Well Summary Data
Former Boeing C-6 Site (Parcel C)
Los Angeles, California

Well Designation	No.of Wells	Well Casing/ Screen Dia. (inches)	Water-Bearing Unit	Screened Interval (ft bgs)
Bio-amendment Injection Wells				
B-Sand Wells	110	2	Upper B-Sand	65 to 85 ft
C-Sand Wells	56	2	C-Sand	95 to 115 ft
Total No. of Injection Wells	166			
Monitoring Wells				
B-Sand Wells	2	2	Upper B-Sand	70 to 85 ft
C-Sand Wells	4	2	C-Sand	95 to 115 ft
Total No. of Monitoring Wells	6			

Table II
Well Installation Schedule
Former Boeing C-6 Site (Parcel C)
Los Angeles, California

Well Installation Phase/ Well Designation	Total Depth of Well (ft bgs)	Well Casing/Screen Diameter (inches)	Water-Bearing Unit	Screened Interval (ft bgs)
Phase I - Geologic Reconnaissance Program Wells (18 Wells Total)				
AW0011	115	2	C-Sand	95 to 115 ft
AW0022	115	2	C-Sand	95 to 115 ft
AW0017	85	2	B-Sand	65 to 85 ft
AW0028	115	2	C-Sand	95 to 115 ft
AW0033	115	2	C-Sand	95 to 115 ft
AW0045	115	2	C-Sand	95 to 115 ft
AW0062	115	2	C-Sand	95 to 115 ft
AW0074	115	2	C-Sand	95 to 115 ft
AW0077	85	2	B-Sand	65 to 85 ft
AW0095	115	2	C-Sand	95 to 115 ft
AW0098	85	2	B-Sand	65 to 85 ft
AW0101	85	2	B-Sand	65 to 85 ft
AW0118	85	2	B-Sand	65 to 85 ft
AW0123	85	2	B-Sand	65 to 85 ft
AW0169	85	2	B-Sand	65 to 85 ft
AW0133	85	2	B-Sand	65 to 85 ft
AW0050	115	2	C-Sand	95 to 115 ft
AW0082	115	2	C-Sand	95 to 115 ft
Phase II - Parcel A Wells (16 Wells Total)				
AW0015	85	2	B-Sand	65 to 85 ft
AW0024	85	2	B-Sand	65 to 85 ft
AW0040	115	2	C-Sand	95 to 115 ft
AW0049	115	2	C-Sand	95 to 115 ft
AW0059	115	2	C-Sand	95 to 115 ft
AW0060	115	2	C-Sand	95 to 115 ft
AW0061	115	2	C-Sand	95 to 115 ft
AW0070	115	2	C-Sand	95 to 115 ft
AW0071	115	2	C-Sand	95 to 115 ft
AW0072	115	2	C-Sand	95 to 115 ft
AW0081	115	2	C-Sand	95 to 115 ft
AW0083	115	2	C-Sand	95 to 115 ft
AW0092	115	2	C-Sand	95 to 115 ft
AW0093	115	2	C-Sand	95 to 115 ft
AW0103	115	2	C-Sand	95 to 115 ft
AW0104	115	2	C-Sand	95 to 115 ft
Phase III - Future Building Pad Wells (37 Wells total)				
AW0166	85	2	B-Sand	65 to 85 ft
AW0167	85	2	B-Sand	65 to 85 ft
AW0168	85	2	B-Sand	65 to 85 ft
AW0170	85	2	B-Sand	65 to 85 ft
AW0023	85	2	B-Sand	65 to 85 ft
AW0030	85	2	B-Sand	65 to 85 ft
AW0031	85	2	B-Sand	65 to 85 ft
AW0038	85	2	B-Sand	65 to 85 ft
AW0039	85	2	B-Sand	65 to 85 ft
AW0047	85	2	B-Sand	65 to 85 ft
AW0048	85	2	B-Sand	65 to 85 ft
AW0057	85	2	B-Sand	65 to 85 ft
AW0058	85	2	B-Sand	65 to 85 ft
AW0067	85	2	B-Sand	65 to 85 ft
AW0068	85	2	B-Sand	65 to 85 ft
AW0069	85	2	B-Sand	65 to 85 ft
AW0078	85	2	B-Sand	65 to 85 ft
AW0079	85	2	B-Sand	65 to 85 ft
AW0080	85	2	B-Sand	65 to 85 ft
AW0089	85	2	B-Sand	65 to 85 ft
AW0090	85	2	B-Sand	65 to 85 ft
AW0091	85	2	B-Sand	65 to 85 ft

Table II
Well Installation Schedule
Former Boeing C-6 Site (Parcel C)
Los Angeles, California

Well Installation Phase/ Well Designation	Total Depth of Well (ft bgs)	Well Casing/Screen Diameter (inches)	Water-Bearing Unit	Screened Interval (ft bgs)
AW0100	85	2	B-Sand	65 to 85 ft
AW0102	85	2	B-Sand	65 to 85 ft
AW0109	85	2	B-Sand	65 to 85 ft
AW0110	85	2	B-Sand	65 to 85 ft
AW0111	85	2	B-Sand	65 to 85 ft
AW0112	85	2	B-Sand	65 to 85 ft
AW0113	85	2	B-Sand	65 to 85 ft
AW0116	85	2	B-Sand	65 to 85 ft
AW0117	85	2	B-Sand	65 to 85 ft
AW0119	85	2	B-Sand	65 to 85 ft
AW0120	85	2	B-Sand	65 to 85 ft
AW0124	85	2	B-Sand	65 to 85 ft
AW0125	85	2	B-Sand	65 to 85 ft
AW0126	85	2	B-Sand	65 to 85 ft
AW0127	85	2	B-Sand	65 to 85 ft
Phase IV - Lot 8 Outside the Future Building Pad Area Wells (95 Wells Total)				
AW0001	85	2	B-Sand	65 to 85 ft
AW0002	85	2	B-Sand	65 to 85 ft
AW0003	85	2	B-Sand	65 to 85 ft
AW0004	85	2	B-Sand	65 to 85 ft
AW0005	85	2	B-Sand	65 to 85 ft
AW0006	85	2	B-Sand	65 to 85 ft
AW0007	85	2	B-Sand	65 to 85 ft
AW0008	85	2	B-Sand	65 to 85 ft
AW0009	85	2	B-Sand	65 to 85 ft
AW0010	85	2	B-Sand	65 to 85 ft
AW0012B	85	2	B-Sand	65 to 85 ft
AW0012C	115	2	C-Sand	95 to 115 ft
AW0013B	85	2	B-Sand	65 to 85 ft
AW0013C	115	2	C-Sand	95 to 115 ft
AW0014	85	2	B-Sand	65 to 85 ft
AW0016	85	2	B-Sand	65 to 85 ft
AW0018	85	2	B-Sand	65 to 85 ft
AW0019B	85	2	B-Sand	65 to 85 ft
AW0019C	115	2	C-Sand	95 to 115 ft
AW0020B	85	2	B-Sand	65 to 85 ft
AW0020C	115	2	C-Sand	95 to 115 ft
AW0021B	85	2	B-Sand	65 to 85 ft
AW0021C	115	2	C-Sand	95 to 115 ft
AW0025	85	2	B-Sand	65 to 85 ft
AW0026B	85	2	B-Sand	65 to 85 ft
AW0026C	115	2	C-Sand	95 to 115 ft
AW0027B	85	2	B-Sand	65 to 85 ft
AW0027C	115	2	C-Sand	95 to 115 ft
AW0028	85	2	B-Sand	65 to 85 ft
AW0029B	85	2	B-Sand	65 to 85 ft
AW0029C	115	2	C-Sand	95 to 115 ft
AW0032B	85	2	B-Sand	65 to 85 ft
AW0032C	115	2	C-Sand	95 to 115 ft
AW0033	85	2	B-Sand	65 to 85 ft
AW0034B	85	2	B-Sand	65 to 85 ft
AW0034C	115	2	C-Sand	95 to 115 ft
AW0035B	85	2	B-Sand	65 to 85 ft
AW0035C	115	2	C-Sand	95 to 115 ft
AW0036B	85	2	B-Sand	65 to 85 ft
AW0036C	115	2	C-Sand	95 to 115 ft
AW0037	85	2	B-Sand	65 to 85 ft
AW0041	115	2	C-Sand	95 to 115 ft
AW0042B	85	2	B-Sand	65 to 85 ft
AW0042C	115	2	C-Sand	95 to 115 ft
AW0043B	85	2	B-Sand	65 to 85 ft
AW0043C	115	2	C-Sand	95 to 115 ft
AW0044B	85	2	B-Sand	65 to 85 ft
AW0044C	115	2	C-Sand	95 to 115 ft
AW0045	85	2	B-Sand	65 to 85 ft

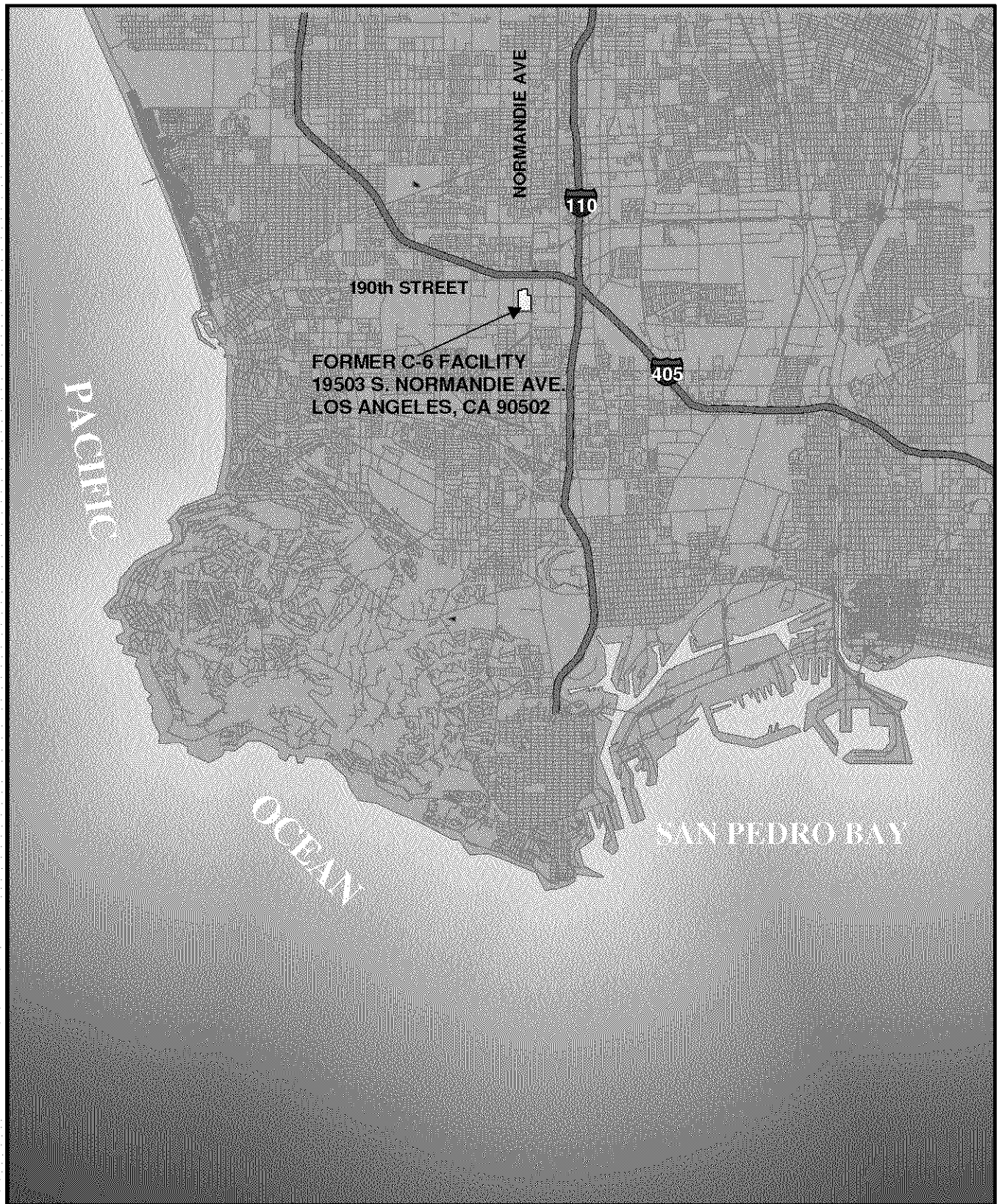
Table II
Well Installation Schedule
Former Boeing C-6 Site (Parcel C)
Los Angeles, California

Well Installation Phase/ Well Designation	Total Depth of Well (ft bgs)	Well Casing/Screen Diameter (inches)	Water-Bearing Unit	Screened Interval (ft bgs)
AW0046	85	2	B-Sand	65 to 85 ft
AW0051	115	2	C-Sand	95 to 115 ft
AW0052	115	2	C-Sand	95 to 115 ft
AW0053B	85	2	B-Sand	65 to 85 ft
AW0053C	115	2	C-Sand	95 to 115 ft
AW0054B	85	2	B-Sand	65 to 85 ft
AW0054C	115	2	C-Sand	95 to 115 ft
AW0055	85	2	B-Sand	65 to 85 ft
AW0058	85	2	B-Sand	65 to 85 ft
AW0063	115	2	C-Sand	95 to 115 ft
AW0064B	85	2	B-Sand	65 to 85 ft
AW0064C	115	2	C-Sand	95 to 115 ft
AW0065B	85	2	B-Sand	65 to 85 ft
AW0065C	115	2	C-Sand	95 to 115 ft
AW0066	85	2	B-Sand	65 to 85 ft
AW0073	115	2	C-Sand	95 to 115 ft
AW0075B	85	2	B-Sand	65 to 85 ft
AW0075C	115	2	C-Sand	95 to 115 ft
AW0076	85	2	B-Sand	65 to 85 ft
AW0084	115	2	C-Sand	95 to 115 ft
AW0085	85	2	B-Sand	65 to 85 ft
AW0086B	85	2	B-Sand	65 to 85 ft
AW0086C	115	2	C-Sand	95 to 115 ft
AW0087	85	2	B-Sand	65 to 85 ft
AW0088	85	2	B-Sand	65 to 85 ft
AW0094	115	2	C-Sand	95 to 115 ft
AW0096B	85	2	B-Sand	65 to 85 ft
AW0096C	115	2	C-Sand	95 to 115 ft
AW0097	85	2	B-Sand	65 to 85 ft
AW0099	85	2	B-Sand	65 to 85 ft
AW0105	115	2	C-Sand	95 to 115 ft
AW0106	115	2	C-Sand	95 to 115 ft
AW0107	85	2	B-Sand	65 to 85 ft
AW0108	85	2	B-Sand	65 to 85 ft
AW0114	85	2	B-Sand	65 to 85 ft
AW0115	85	2	B-Sand	65 to 85 ft
AW0121	85	2	B-Sand	65 to 85 ft
AW0122	85	2	B-Sand	65 to 85 ft
AW0128	85	2	B-Sand	65 to 85 ft
AW0129	85	2	B-Sand	65 to 85 ft
AW0130	85	2	B-Sand	65 to 85 ft
AW0131	85	2	B-Sand	65 to 85 ft
AW0132	85	2	B-Sand	65 to 85 ft
AW0134	85	2	B-Sand	65 to 85 ft
Phase V - Monitoring Wells (6 Wells Total)				
MWC002	115	2	C-Sand	95 to 115 ft
MWC004	115	2	C-Sand	95 to 115 ft
MWC006	115	2	C-Sand	95 to 115 ft
MWC007	115	2	C-Sand	95 to 115 ft
MWB006	85	2	B-Sand	70 to 85 ft
MWB007	85	2	B-Sand	70 to 85 ft

Note: The total depth, screen interval and sample order may be revised based on results of the Phase I Geologic Reconnaissance Program

Wells designated with AWBxxx are B-Sand wells of 2 well nest.
Wells designated with AWCxxx are C-Sand wells of 2 well nest.

FIGURES



N

2 1 0 2 Miles

HALEY & ALDRICH

UNDERGROUND ENGINEERING & ENVIRONMENTAL SOLUTIONS

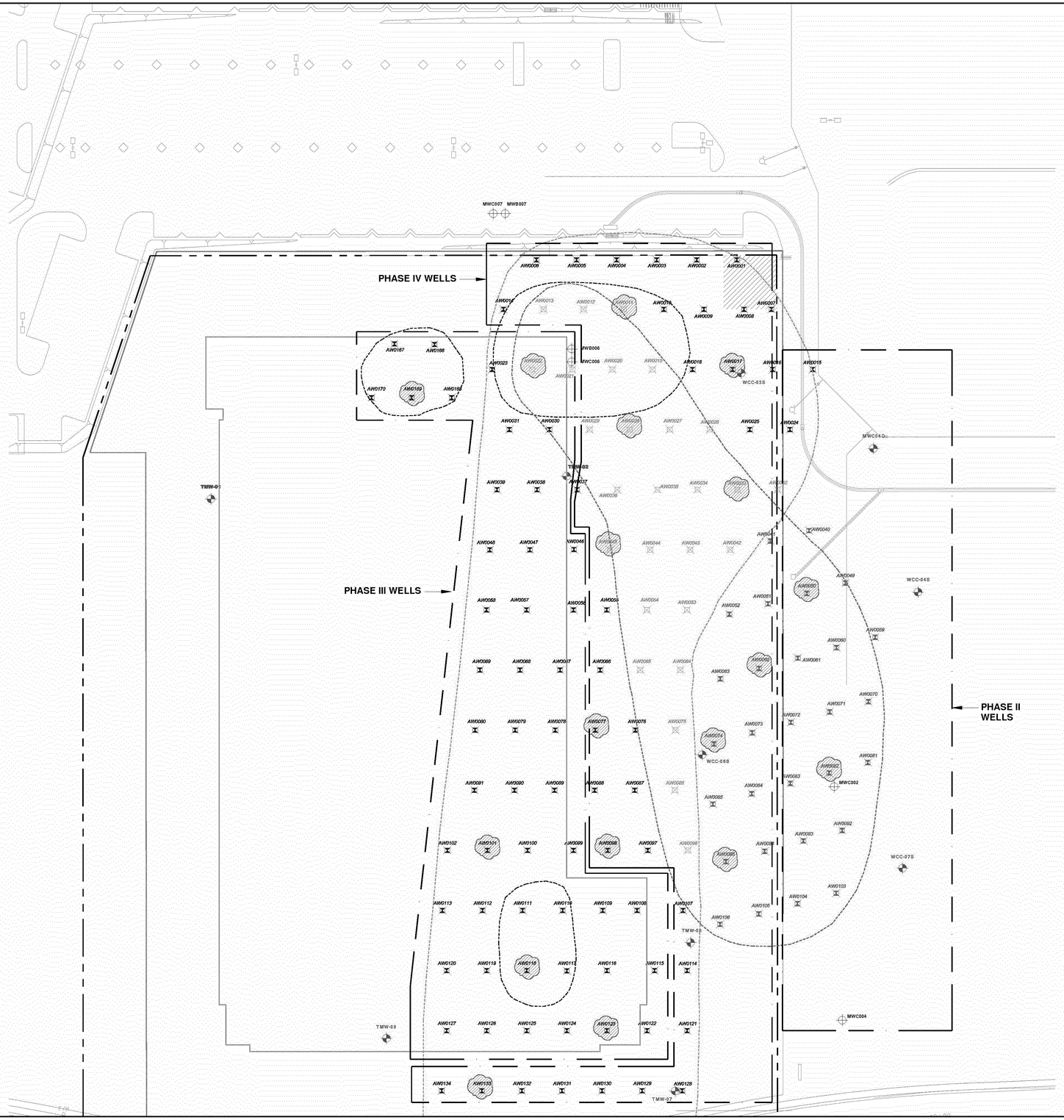
BOEING REALTY CORPORATION
FORMER C-6 FACILITY
LOS ANGELES, CALIFORNIA

FIGURE 1

SITE LOCATION PLAN

SCALE AS SHOWN

AUGUST 2004



LEGEND

- AW0001 — SINGLE B-SAND AMENDMENT WELL (AW) LOCATION
- AW0013 — TWO (B-SAND/C-SAND) AMENDMENT WELL (AW) LOCATION
- AW0070 — SINGLE C-SAND AMENDMENT WELL (AW) LOCATION
- AW0011 — AMENDMENT WELL SELECTED FOR CONTINUOUS CORE LOGGING FOR RECONNAISSANCE PURPOSE (PHASE I WELLS)
- TMW-01 — EXISTING GROUNDWATER MONITORING WELL
- MWC004 — PROPOSED GROUNDWATER MONITORING WELL (MW) LOCATION (PHASE V)
- UPPER B-SAND 5,000 UG/L TRICHLOROETHENE CONTOUR
- LOWER B-SAND 5,000 UG/L TRICHLOROETHENE CONTOUR
- C-SAND 5,000 UG/L TRICHLOROETHENE CONTOUR
- PARCEL BOUNDARY

NOTE:
THE LOCATIONS OF THE AMENDMENT WELLS (AW) (OTHER THAN THE PHASE I AWs) AND PROPOSED MONITORING WELLS SHOWN ON THIS FIGURE ARE PRELIMINARY LOCATIONS. FINAL LOCATIONS WILL BE CONFIRMED, SURVEYED, AND MARKED ONCE DEVELOPMENT PLANS ARE FINALIZED.

- N -

0 20 40 80

APPROXIMATE SCALE IN FEET

HALEY & ALDRICH

UNDERGROUND ENGINEERING & ENVIRONMENTAL SOLUTIONS

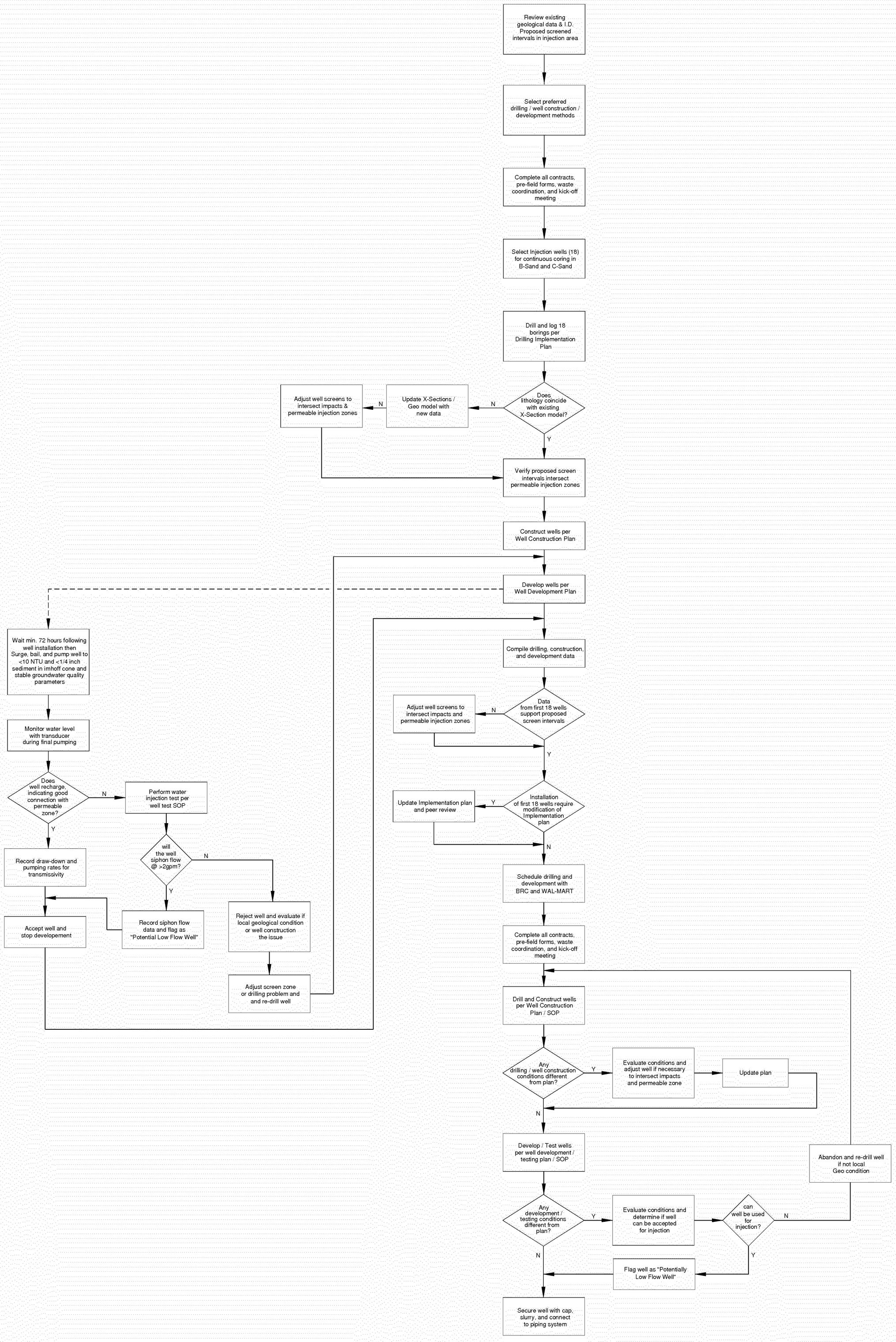
BOEING REALTY COPRPORATION
FORMER C-6 FACILITY SITE
LOS ANGELES, CALIFORNIA

FIGURE 2

AMENDMENT WELLS/ MONITORING WELLS LOCATION MAP

SCALE: AS SHOWN

AUGUST 2004



(604) 28882D01_FLOW CHART

HALEY & ALDRICH

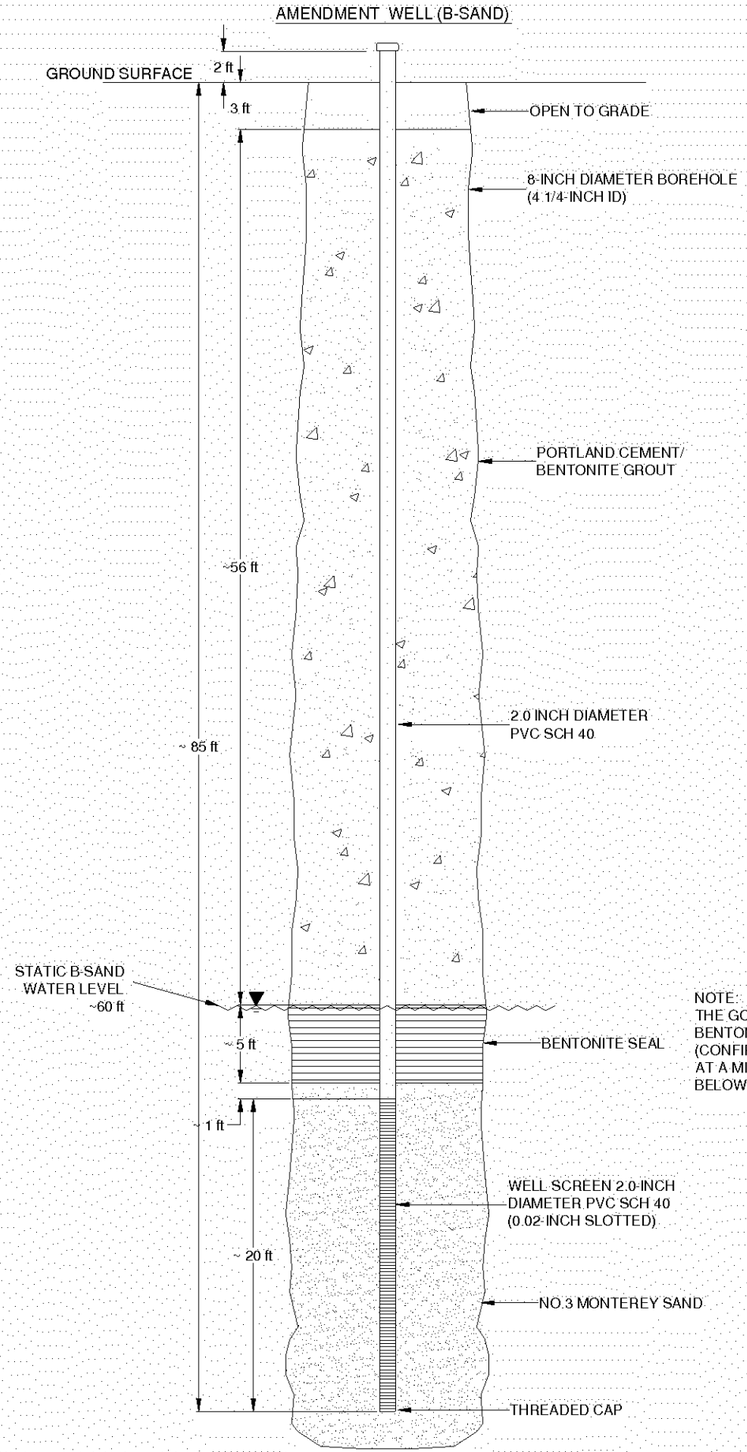
UNDERGROUND ENGINEERING & ENVIRONMENTAL SOLUTIONS

BOEING REALTY CORPORATION
FORMER C-6 FACILITY
LOS ANGELES, CALIFORNIA

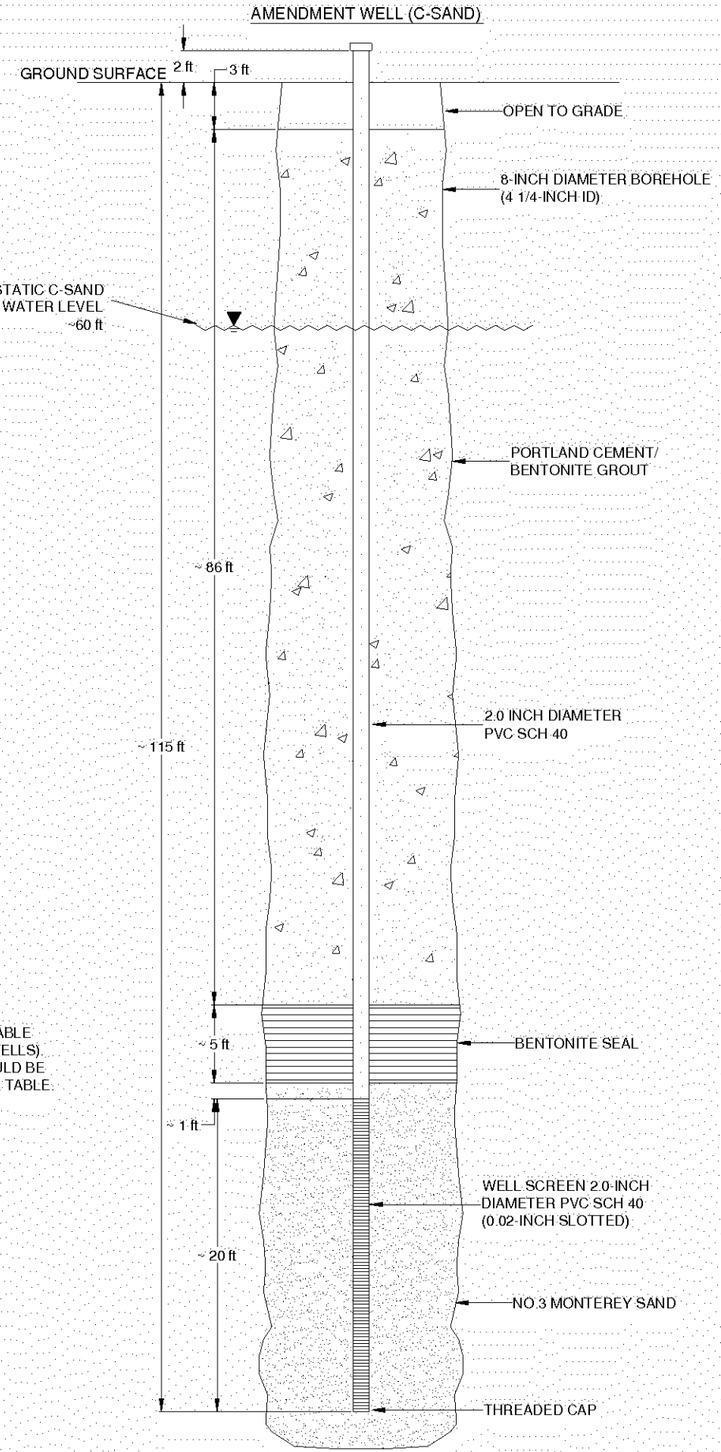
FIGURE 3

AMENDMENT WELL CONSTRUCTION PLAN FLOW CHART PARCEL C GROUNDWATER REMEDIATION

AUGUST 2004



NOTE:
THE GOAL IS TO HAVE AS MUCH OF THE BENTONITE SEAL BELOW THE WATER TABLE (CONFIRMED BY MEASURING NEARBY WELLS). AT A MINIMUM, 2.5FT OF THE SEAL SHOULD BE BELOW THE CONFIRMED STATIC WATER TABLE.



(604) 28026B01

HALEY & ALDRICH
UNDERGROUND ENGINEERING & ENVIRONMENTAL SOLUTIONS

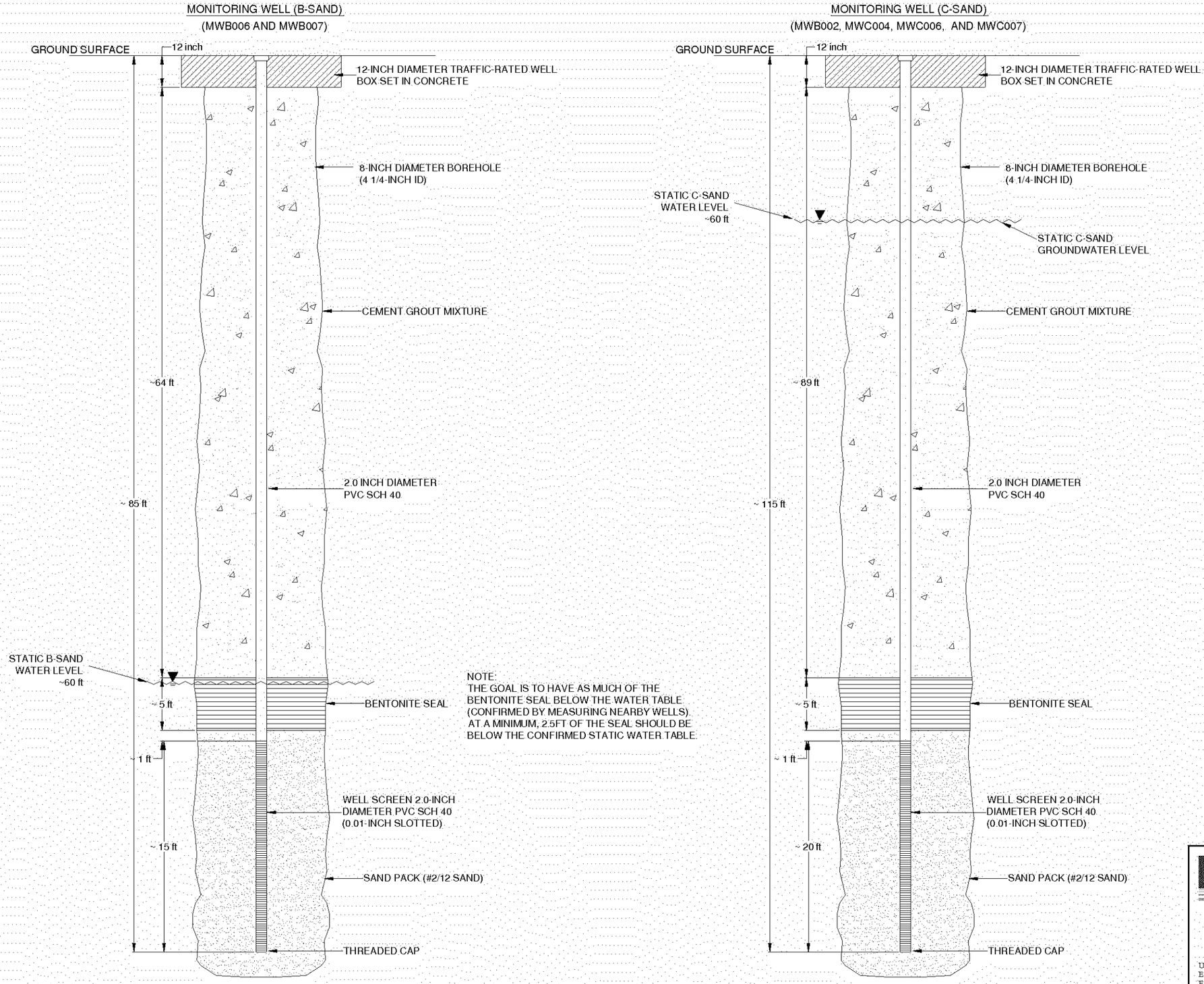
BOEING REALTY CORPORATION
FORMER C-6 FACILITY (BUILDING 1/36 AREA)
LOS ANGELES, CALIFORNIA

FIGURE 4

TYPICAL CONSTRUCTION DETAIL FOR AMENDMENT WELLS

SCALE: NOT TO SCALE

AUGUST 2004


MONITORING WELL (B-SAND)
(MWB006 AND MWB007)
GROUND SURFACE
12 inch
12-INCH DIAMETER TRAFFIC-RATED WELL BOX SET IN CONCRETE
8-INCH DIAMETER BOREHOLE (4 1/4-INCH ID)
CEMENT GROUT MIXTURE
~64 ft
~ 85 ft
2.0 INCH DIAMETER PVC SCH 40
STATIC B-SAND WATER LEVEL ~60 ft
~ 5 ft
BENTONITE SEAL
~ 1 ft
WELL SCREEN 2.0-INCH DIAMETER PVC SCH 40 (0.01-INCH SLOTTED)
~ 15 ft
SAND PACK (#2/12 SAND)
THREADED CAP
NOTE:
THE GOAL IS TO HAVE AS MUCH OF THE BENTONITE SEAL BELOW THE WATER TABLE (CONFIRMED BY MEASURING NEARBY WELLS). AT A MINIMUM, 2.5FT OF THE SEAL SHOULD BE BELOW THE CONFIRMED STATIC WATER TABLE.
MONITORING WELL (C-SAND)
(MWB002, MWC004, MWC006, AND MWC007)
GROUND SURFACE
12 inch
12-INCH DIAMETER TRAFFIC-RATED WELL BOX SET IN CONCRETE
8-INCH DIAMETER BOREHOLE (4 1/4-INCH ID)
STATIC C-SAND WATER LEVEL ~60 ft
STATIC C-SAND GROUNDWATER LEVEL
CEMENT GROUT MIXTURE
~ 89 ft
~ 115 ft
2.0 INCH DIAMETER PVC SCH 40
~ 5 ft
BENTONITE SEAL
~ 1 ft
WELL SCREEN 2.0-INCH DIAMETER PVC SCH 40 (0.01-INCH SLOTTED)
~ 20 ft
SAND PACK (#2/12 SAND)
THREADED CAP
(604) 28026B01
HALEY & ALDRICH
UNDERGROUND ENGINEERING & ENVIRONMENTAL SOLUTIONS
BOEING REALTY CORPORATION
FORMER C-6 FACILITY (BUILDING 1/36 AREA)
LOS ANGELES, CALIFORNIA
FIGURE 5
TYPICAL CONSTRUCTION DETAIL FOR GROUNDWATER MONITORING WELLS
SCALE: NOT TO SCALE
AUGUST 2004

APPENDIX A

Field Forms

Tailgate Safety Meeting Report

The Tailgate Safety Meeting is to supply Haley & Aldrich staff information regarding potential hazards that may be encountered at the site.

Observations of unsafe work practices/conditions that have developed since previous meeting: _____

_____

_____

_____

Location of (or changes in the location of) evacuation routes/safe refuge areas: _____

_____

_____

_____

Additional Comments: _____

_____

_____

_____

Attendees signatures below indicate that they have attended a briefing on the requirements of the Haley & Aldrich, Inc. Health & Safety Plan for the on-site work tasks, and declare that they understand the provisions and procedures set forth herein while working on this site.

Name (printed)	Signature	Company

Meeting conducted by: _____ Title: _____

Signature: _____ Date/Time: _____

Site Access Log
Parcel C Groundwater Remediation Well Installation Program
Former Boeing C-6 Site
Los Angeles, California

DATE:_____________________________ **Page ______ of ______**

This Site Access Log is to be signed by all visitors to the Site.

Visitor signatures below indicate that they are aware that this is an active construction site and that they have been briefed by the Haley & Aldrich, Inc. Health & Safety Coordinator as the the potential risks and dangers associated with the Site. All visitors to work areas on the Site must wear hard hats, safety glasses, and steel-toed boots while visiting this Site.

Name (printed)	Signature	Company/Time In and Out

HALEY & ALDRICH

DAILY ACTIVITY REPORT

Page of

Project _____ **Field Representative** _____

Client _____ **Date** _____

Well No. _____ **Weather** _____

Subcontractor _____ **Temperature** _____

☐ ☐

Activity Type ☐ 1166 Monitoring ☐ Assessment Confirmation ☐ Excavation ☐ Fill and Material Placement

☐ Hallow Stem Auger ☐ HASP Monitoring ☐ Impact Assessment ☐ Soil Vapor

☐ Stockpile Management ☐ Other.... _____

Monitoring Equipment ☐ PID ☐ FID ☐ CGI ☐ Dust Monitor ☐ Colorimetric ☐ Other _____

Equipment Type _____

Start Time _____ **End Time** _____ **Number of Personnel on Site** _____

Day Type ☐ Regular ☐ Extended ☐ Other _____

Summary _____

Issues _____

Documents

Name	Type	Description

HALEY & ALDRICH

DAILY FIELD REPORT

Page of

Project		**Report No.**	
Location		**Date**	
Client		**Page**	of
Contractor		**File No.**	
Weather		**Temperature**	

Field Representative(s)	**Time on site**	**Report/Travel/Other**	**Total hours**

Distribution:

Haley & Aldrich, Inc.

Form 4004

HALEY & ALDRICH

Soil Boring Log for _____

Project	Former Boeing C-6 Site	**Drilling Company**	
Project Number	28882-604	**Drill Rig**	
Client	Boeing Realty Corporation	**Drilling Method**	
Geologist		**Date Drilled**	
Borehole Diameter		**Total Depth**	**Depth To Water**

Description	Depth (feet)	Soil Type	Graphic Log	Sample Interval	Blows/ 6 in.	PID (ppm)	Recovery	Sample Collected	Well Diagram
	1								
	2								
	3								
	4								
	5								
	6								
	7								
	8								
	9								
	10								
	11								
	12								
	13								
	14								
	15								
	16								
	17								
	18								
	19								
	20								

HALEY & ALDRICH

Soil Boring Log for _____

Project	Drilling Company
Project Number	Date Drilled

Description	Depth (feet)	Soil Type	Graphic Log	Sample Interval	Blows/ 6 in.	PID (ppm)	Recovery	Sample Collected	Well Diagram
	21								
	22								
	23								
	24								
	25								
	26								
	27								
	28								
	29								
	30								
	31								
	32								
	33								
	34								
	35								
	36								
	37								
	38								
	39								
	40								

HALEY & ALDRICH

Soil Boring Log for _____

Project	Drilling Company
Project Number	Date Drilled

Description	Depth (feet)	Soil Type	Graphic Log	Sample Interval	Blows/ 6 in.	PID (ppm)	Recovery	Sample Collected	Well Diagram
	41								
	42								
	43								
	44								
	45								
	46								
	47								
	48								
	49								
	50								
	51								
	52								
	53								
	54								
	55								
	56								
	57								
	58								
	59								
	60								

HALEY & ALDRICH

Soil Boring Log for _____

Project	Drilling Company
Project Number	Date Drilled

Description	Depth (feet)	Soil Type	Graphic Log	Sample Interval	Blows/ 6 in.	PID (ppm)	Recovery	Sample Collected	Well Diagram
	61								
	62								
	63								
	64								
	65								
	66								
	67								
	68								
	69								
	70								
	71								
	72								
	73								
	74								
	75								
	76								
	77								
	78								
	79								
	80								

HALEY & ALDRICH

Soil Boring Log for _____

Project	Drilling Company
Project Number	Date Drilled

Description	Depth (feet)	Soil Type	Graphic Log	Sample Interval	Blows/ 6 in.	PID (ppm)	Recovery	Sample Collected	Well Diagram
	81								
	82								
	83								
	84								
	85								
	86								
	87								
	88								
	89								
	90								
	91								
	92								
	93								
	94								
	95								
	96								
	97								
	98								
	99								
	100								

HALEY & ALDRICH

Soil Boring Log for _____

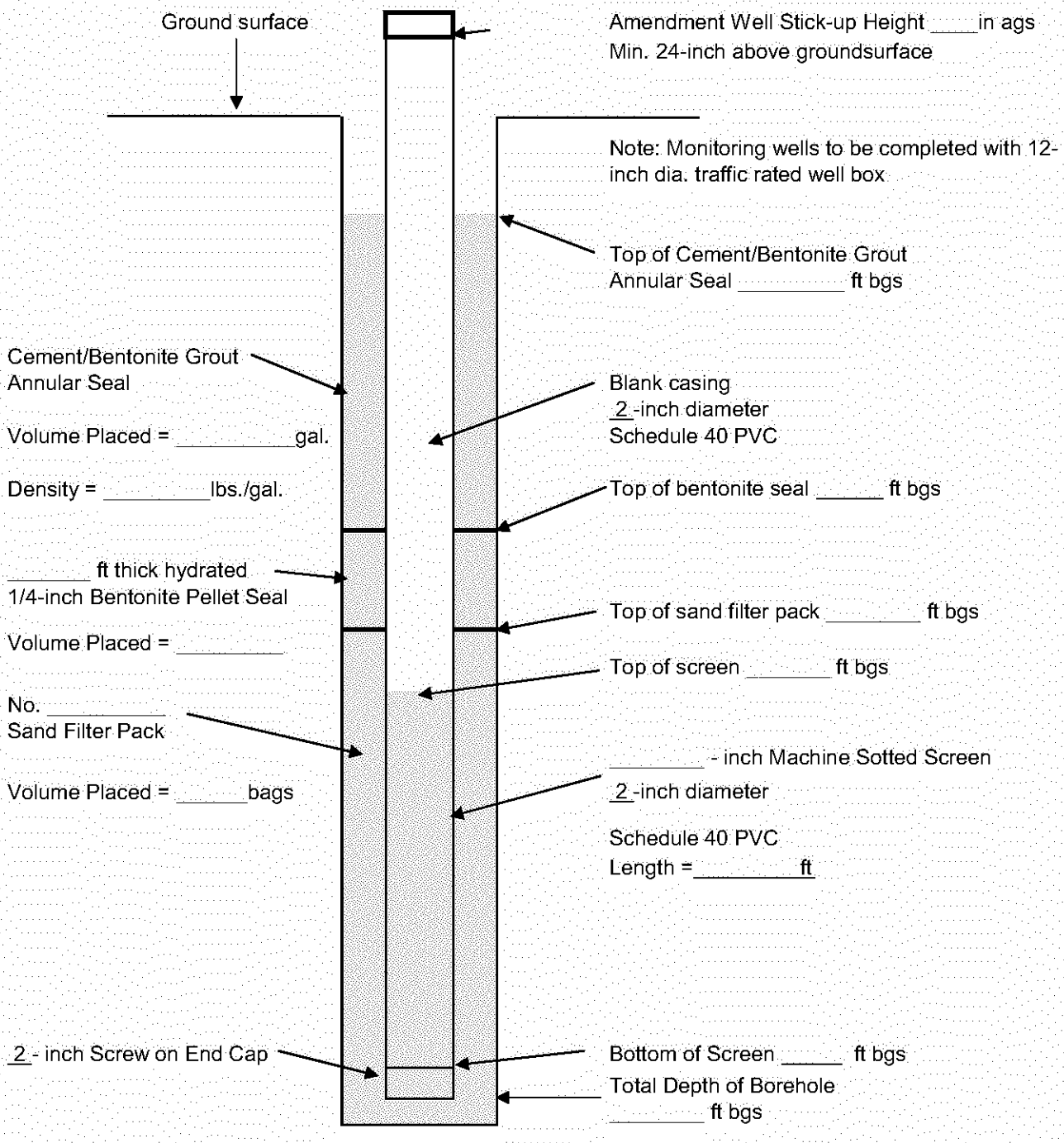
Project	Drilling Company
Project Number	Date Drilled

Description	Depth (feet)	Soil Type	Graphic Log	Sample Interval	Blows/ 6 in.	PID (ppm)	Recovery	Sample Collected	Well Diagram
	101								
	102								
	103								
	104								
	105								
	106								
	107								
	108								
	109								
	110								
	111								
	112								
	113								
	114								
	115								
	116								
	117								
	118								
	119								
	120								

Well Construction Record
Parcel C Remediation Well Installation Program
Former Boeing C-6 Site
Los Angeles, California

Well No.: _____

Date: _____



Well Development Record

Project Name _____ **Well Number** _____
Project Location _____ **Weather** _____
Project Number _____ **Date** _____
Page _____ **of** _____

Water Level Data (from top of casing)

Total Well Depth (TD) _____ Casing Diameter (inches) _____
Static Water Level (DTW) _____ Screen Length (feet) _____
Standing Water Column (WC) _____ Borehole Diameter (inches) _____
(TD - DTW) _____ Date Installed _____

Well Purging Data

Purge Method _____ (gpm) _____
Well Volume (gallons) _____ Pump Description _____
CD* (2" - 0.163, 2.5" - 0.255 4" - 0.653, 6" - 1.469) _____
Number of Volumes to be Purged _____ _____
Total Gallons to be Purged _____ Drilling Company _____

Surging and Bailing

Start Time: _____ Finish Time: _____ Comments: _____
Start Time: _____ Finish Time: _____ Comments: _____
Start Time: _____ Finish Time: _____ Comments: _____
Start Time: _____ Finish Time: _____ Comments: _____

Pumping Parameters

Time	Volume (gallons)	Pumping Rate (gpm)	Temp (°C)	Spec. Cond. (mmhos/cm)	pH (units)	Comments (color, turbidity, odor, sheen)

Well Development Record

Project Name _____ Well Number _____

Project Location _____ Date _____

Project Number _____ Page _____ of _____

Field Parameters cont'd

Time	Volume (gallons)	Pumping Rate (gpm)	Temp (°C)	Spec. Cond. (mmhos/cm)	pH (units)	Comments (color, odor, sheen)

Additional Comments _____

Amendment Well Water Injection Test Form

Project Name		Well Number	
Project Location		Page	of
Project Number		Technician Name	
Date		Date Well Installed	
Height of Well Head Stick-up		Date Well Developed	
Observation Wells Used		Weather	

Well I.D.	Time (24 hr)	Depth to Water In Well (feet below TOC)	Line Pressure (psi)	Well Head Pressure (psi)	Flow Rate (gpm)	Injection Volume (Running Total) (gal.)	Totalizer Reading (gal.)	Depth to Water in Obs. Well No. 1 (ft)	Depth to Water in Obs. Well No. 2 (ft)	Comments/Observations

HALEY & ALDRICH

Amendment Well Water Injection Test Form (Continued)

Date: Technician Name: Page ____ of _____

Well I.D.	Time (24 hr)	Depth to Water In Well (feet below TOC)	Line Pressure (psi)	Well Head Pressure (psi)	Flow Rate (gpm)	Injection Volume (Running Total) (gal.)	Totalizer Reading (gal.)	Depth to Water in Obs. Well No. 1 (ft)	Depth to Water in Obs. Well No. 2 (ft)	Comments/Observations

WASTE INVENTORY MANAGEMENT TABLE
Lot 8 - Groundwater Remediation Well Installation Program
Former Boeing C-6 Site
Los Angeles, California

H&A ID	Container Type	Ship Date	Container Condition	Matrix	Current Location	Source	Contents	Accumulation Start Date	Generation Date	Label	Elapsed Days	Generated By	Profile Samples Collected & Date	Data sent to Boeing Date	Disposition	Comments

NOTES:
N/A = Not Applicable

APPENDIX B

Well Installation QA/QC Measures

WELL INSTALLATION QUALITY ASSURANCE/ QUALITY CONTROL MEASURES FOR LOT 8 – PARCEL C GROUNDWATER REMEDIATION WELL INSTALLATION PROGRAM FORMER BOEING C-6 FACILITY LOS ANGELES, CALIFORNIA

by:

Haley and Aldrich, Inc.
San Diego, California

for:

Boeing Realty Corporation
Long Beach, California

File No. 28882-604
16 August 2004

HALEY & ALDRICH

1. WELL INSTALLATION QA/QC MEASURES

To ensure the AW installation program meets the goals required for the successful remediation of the Site, the following Quality Assurance/Quality Control (QA/QC) measures have been developed.

- Development of a Project Team Organization with clear designated responsibilities regarding QA/QC during the well installation program.
- Developing Standard Operating Procedures (SOPs) to be followed during field activities (Appendices B and C).
- Identifying QA/QC Procedures to ensure SOPs are followed and documented.

1.1 Project Team Organization

The roles of the project team members are described below.

Task Manager

H&A will designate an individual to manage the well installation task associated with the Site groundwater remediation program. The Task Manager is responsible for overseeing and implementing well installation activities and coordinating with property owners, contractors, and regulatory agencies. The Task Manager will prepare well installation task orders for each phase of work and coordinate with the contractors (e.g., driller, geophysical clearance contractor, etc.); coordinate appropriate location and marking of underground utilities prior to a drilling event; organize field data; direct and coordinate the field geologist; ensure applicable QA/QC procedures are implemented; and implement applicable health and safety procedures.

1.1.2 Health and Safety Coordinator

H&A will designate an on-site Health and Safety Coordinator prior to implementation of well drilling activities. The Health and Safety Coordinator is responsible for implementing the provisions of the site-specific Health and Safety Plan (HSP) for all field activities. All health and safety aspects of the field activities will be coordinated with the H&A Regional Health and Safety Coordinator. The on-site Health and Safety Coordinator may also be the Field Coordinator.

1.1.3 Field Coordinator/Supervising Geologist

The Field Coordinator/Supervising Geologist will be responsible for the coordination and effective use of all field personnel on-site and for maintaining a record of field activities. The Field Coordinator will also be responsible for field quality control including issuance and tracking of measurement and test equipment, the proper labeling, handling, storage, shipping, and chain-of-custody procedures used at the time of well

installation, and control and collection of all field documentation (field activity log book, boring logs, well construction logs, notebooks, well development and testing data sheets, etc.) during field investigation activities.

1.1.4 Oversight Geologists

Oversight Geologists are required to be familiar with the specific requirements of this Implementation Plan for those activities associated with the well installation, development and testing activities. In addition, the site-specific HSP must be read and signed-off by each participating oversight geologist.

Oversight geologists will assist the Field Coordinator/Supervising Geologist and the Task Manager in all activities required for the well installation program. An oversight geologist has the following responsibilities:

- Organizing and mobilizing monitoring equipment and materials;
- Ensuring equipment is in working order;
- Oversight of drilling contractor during well installation to ensure compliance with well construction, development and testing SOPs;
- Taking field measurements;
- Decontaminating monitoring and sampling equipment;
- Labeling and packaging samples;
- Completing chain-of-custody forms;
- Completing field forms;
- Maintaining field records (log book entries, equipment calibration records, etc.)
- Completing Boeing EDMS portal data logs and uploading to portal

1.2 Field Quality Control Procedures

The purpose of this section is to present quality control procedures required during the well installation program. This section includes general procedures and guidelines for:

- Pre-mobilization preparation;
- Organization, calibration and use of field instruments and materials;
- Field documentation and chain-of-custody control;
- Sample Storage, Transport, and Chain-of-Custody; and
- Decontamination procedures.

1.2.1 Pre-mobilization Preparation

Activities to be completed by project personnel in preparation for mobilization to the Site are described below. These activities will be performed before initiating well installation activities to achieve efficient use of field time and ensure that program objectives are met.

Prior to mobilization to the Site, personnel will review available applicable background information on the Site and Site geology. This information might include background environmental investigation activities documented in previous reports, existing geologic data, previous project work plans, or the site-specific HSP. Review of this information will allow the field personnel to become familiar with the location, general condition, and expected geologic conditions to be encountered during the well installation program.

1.2.2 Organizing, Calibration and Use of Field Equipment and Materials

It is the responsibility of oversight personnel to ensure that the required monitoring equipment, health and safety equipment, and materials are available on-site before initiation of a well installation activity. The HSP provides a complete listing of health and safety equipment necessary to support field activities.

Field activities log books, field log forms, well development forms, well injection test forms, sample labels, and chain-of-custody forms will be used to document the sampling events and track the custody of the samples from collection through shipment to the laboratory for analysis.

Prior to drilling, oversight personnel will clean, calibrate, and check all equipment for possible malfunction. Calibration procedures provided by the manufacturer will be followed, or in the absence of such information, standard acceptable calibration methods will be used. A field meter log book will be maintained for field meter calibrations.

In general, a calibration verification of the field instruments will be performed prior to initial use in the field, at least once more during the day, and whenever signs of instrument malfunction or questionable readings are observed.

1.2.3 Field Documentation

A field activities log book will be maintained for all daily well installation, development and testing activities. This log book provides a record of significant events experienced during field activities, along with any other comments that will aid in the ability to reconstruct field activities without reliance on memory. Any deviation from the well construction, development or testing SOPs will be logged, including justification and circumstances. Entries will be made in waterproof black ink. In the case of an error, corrections will be made by crossing a single line through the incorrect information and entering the correct information. All corrections will be initialed and dated.

Additional field documentation will be required for each specific well installation activity and is described in detail in the SOPs in the appendices to this document. These field documents may include the following forms:

- Boring Log Form
- Well Construction Record
- Well Development Record
- Field Parameter Form

- Well Injection Test Form
- Chain-of-Custody Form
- Daily Field Report
- Health and Safety Daily Meeting Form
- Site Access Log

The Field Coordinator or designee will be responsible for organizing the appropriate log forms into a 3-ring binder for the oversight geologist(s). Copies of the field forms are included in Appendix A. Specific measurements to be recorded during the well installation program include:

- Confirm measurements of total depth of borings.
- Confirm measurements of length of screen and casing prior to placement in the boring.
- Confirm measurements of depths and volumes used of filter pack.
- Confirm depths and volumes of bentonite seal and hydration lifts.
- Confirm placement and volume of annular seal grout.
- Total depth to bottom of well following installation, noting condition of bottom (e.g., hard, soft, etc.)

The Task Manager/Supervising Geologist will review of Daily Field Reports, Well Construction Record, Well Development Records, and Injection Testing forms on a daily basis. These documents will be transmitted to the Boeing Project Manager every two days for review.

1.3 Sample Collection, Storage, Transport, and Chain-of-Custody

Samples to be collected during the well installation program include soil core samples for sieve analyses and possibly IDW samples for waste profiling purposes. Each sample container will have an individual sample label. Sample labels will have an adhesive coating on the back to stick to sample containers. Each sample label will contain the following information:

- Project number;
- Project name (soil sampling, IDW sampling, etc.);
- Location;
- Date and time of sample collection;
- Preservative, where applicable;
- Sample identification (ID) number (a unique 5-character sample number);
- Requested analyses, where applicable; and
- Sampler's initials.

Following sample collection and labeling, samples will be packaged for transport to the geotechnical and analytical laboratories. Analytical samples will be stored in a cooler with ice, ice packs, or dry ice, and shipped to the laboratory within 48 hours of

collection. Geotechnical samples will be stored in plastic bags and boxes or coolers and shipped to the geotechnical laboratory. The following shipping procedures will be used:

- For analytical samples, ice will be placed in the coolers and used to cool samples to approximately 4 degrees C.
- Signed and dated chain-of-custody forms will be taped to the cooler lid inside a resealable bag prior to shipping.
- Coolers will be picked up at the site by designated courier or laboratory personnel. The couriers will be briefed on securing loads and inspected prior to leaving the Site. Coolers may also be delivered to the laboratory by H&A personnel within 48 hours of sample collection.

The following shipping precautions, as judged necessary by the field coordinator, may be used:

- Clear tape may be placed around each sample label to prevent labels from falling off (with the exception of VOA samples).
- Glass sample containers may need to be wrapped in bubble pack to prevent breakage and transported in a sealed cooler or other suitable container.
- The shipping containers (coolers) may be clearly labeled with sufficient information (name of project, time and date container was sealed, person sealing the container, and consultant's office name and address) to enable positive identification.
- Couriers will be briefed on the need for securing loads and inspected prior to leaving the Site.

Chain-of-custody procedures will be followed in accordance with standard EPA protocol in order to track the custody of the samples. A copy of H&A's chain-of-custody form, which will be used to document sample custody, is provided in Appendix A. The chain-of-custody form is designed to document the transfer of samples from the field to the laboratory. As such, the form summarizes the contents of the shipment and tracks the dates and times of any custody transfer, and signatures of all parties relinquishing and receiving the samples. The sampler must sign the chain-of-custody form(s) in the designated sampler space and the relinquished by space. The pink copy of the form is then removed from the back and the white and yellow forms are placed in the sealed plastic bag and sealed inside the cooler. When completed, this form will contain the following information:

- Sample numbers (corresponding to the sample ID numbers on the sample labels);
- Project number;
- Project/client name and location;
- Sampler's signature;
- Date/time of sample collection;
- Type of samples (e.g., sludge, soil, groundwater, etc.);

- Analytical requirements;
- Number and type of containers (e.g., 40-ml glass VOA, SS sleeve, etc.);\
- Remarks (e.g., samples filtered in the field, etc.);
- Date/time samples relinquished by; and
- Date/time samples received by

From the time the sample is collected, it will be under the direct control of H&A personnel. Before H&A personnel relinquish the samples to the designated courier or a laboratory representative picking up the samples from the site, the seals will be removed and their condition documented in the field activities logbook. The samples will then be relinquished to the designated courier or laboratory representative and the chain-of-custody forms will be sealed inside the cooler. New custody seals will be placed on the outside of the cooler, with their identification number recorded on the chain-of-custody form.

In the event that a courier, such as Federal Express, is used to transport samples, the chain-of-custody form will be sealed inside the cooler, taped to the top lid in a sealed bag and custody seals will be taped on the outside edges of the cooler or across the cooler latch. The designated courier will not sign the chain-of-custody form, but will provide either a bill-of-lading or air bill showing they received the cooler and who the cooler is being shipped to. The bill-of-lading (air bill) number will be indicated in the field activities logbook and a copy of the bill-of-lading (air bill) form will be retained until the cooler arrives at the laboratory.

Copies of the chain-of-custody forms will be returned by the laboratory with the analytical results. The form will indicate personal custody of the sample by dated signature, and the analytical suite for each sample. More than one sample may appear on a chain-of-custody form.

All samples collected will be labeled in a clear and precise way for proper identification in the field and for tracking in the laboratory. The samples will have pre-assigned, identifiable, and unique numbers. At a minimum, the sample labels will contain the following information: Site Name, sample location, date of collection, analytical parameter(s), and method of preservation. Every sample, including samples collected from a single location but going to separate laboratories, will be assigned a unique sample number.

In the event that reusable sampling equipment is used during field activities, such equipment will be decontaminated after each sample is collected to minimize the potential for cross-contamination between samples. Where appropriate, disposable sampling equipment should be used to reduce the chances for cross-contamination (e.g., disposable Teflon bailers, filters, discharge tubing, etc.). Decontamination solutions will be prepared for cleaning sampling equipment in the field, unless otherwise specified in the implementing documentation. The field decontamination procedure for sampling equipment will include, at a minimum, washing equipment in each of the following solutions:

- Solution #1 - Tapwater rinse/flush;
- Solution #2 - Non-ionic detergent (i.e., Alconox) and tapwater scrub;
- Solution #3 - Tapwater rinse/flush;
- Solution #4 - Deionized water rinse/flush

Any deviation from this procedure will be called out in the Daily Field Report. All decontamination water will be collected in buckets or other appropriate containers and disposed in accordance with procedures provided in Section 3.3.

1.4 Health & Safety

All oversight work will be performed under the guidance of a Site-specific Health and Safety Plan (HSP) prepared for the Site. The drilling contractor will work under their own Site-Specific HSP. The following items will be performed, or will be on-Site during the well installation program:

- Oversight personnel will review and sign the Site-Specific Health and Safety Plan.
- A copy of the HSP will be provided to the drilling contractor for review and reference.
- A copy of the Site-specific Standard Practices and Emergency Contacts Card will be in the possession of all oversight personnel.
- Oversight personnel will review the Driller's Site-Specific Health and Safety Plan.
- PPE requirements identified in the HSP will be on-Site and used by all oversight personnel as required in the HSP.
- Site conditions and drilling equipment for safety will be inspected prior to start of work each day.
- A Site Access Log will be maintained by the Field Coordinator and will include the; Name, Company/Agency, arrival and departure times, and reason for being on-Site. The Task Manager, H&A Project Manager and Boeing Project Manager will be informed when anyone beside the oversight and well installation contractors' personnel visit the Site.
- Health and Safety Tailgate meetings will be held before the start of work each day. All oversight and drilling contractor personnel will attend these meetings and sign an attendance log.
- Work area and perimeter air monitoring will be performed according to the requirements of the HSP. Readings will be record on an Air Monitoring Form included in the HSP.
- A Health and Safety Audit may be performed by a health and safety professional other than the Site Health and Safety Coordinator for QA/QC purposes during the field work.

APPENDIX C

Well Construction and Abandonment Standard Operating Procedures

WELL CONSTRUCTION AND DESTRUCTION STANDARD OPERATING PROCEDURES FOR LOT 8 – PARCEL C GROUNDWATER REMEDIATION WELL INSTALLATION PROGRAM FORMER BOEING C-6 FACILITY LOS ANGELES, CALIFORNIA

by:

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San Diego, California

for:

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Long Beach, California

File No. 28882-604
16 August 2004

HALEY& ALDRICH

1. INTRODUCTION

The purpose of this document is to present the standard operating procedures (SOPs) required for installing and constructing 166 amendment wells (AWs) and seven groundwater monitoring wells (MWs) in Parcel C of the former Boeing C-6 facility (Site) in Los Angeles, California. The wells are to be installed as part of the groundwater remediation program for the Site. This document also presents the procedures to be used if an AW or MW has to be destroyed.

The AWs and MWs will be installed into the B-Sand or the C-Sand in five phases of work, described below:

- Phase I – 18 geologic reconnaissance AWs will be drilled at selected locations in Lot 8 and Parcel A of the Site;
- Phase II – 17 AWs will be installed in Parcel A of the Site;
- Phase III – 40 AWs will be installed in the graded pad of the future building planned for Lot 8.
- Phase IV – 81 AWs will be installed in Lot 8 in areas outside the area of the building pad.
- Phase V – seven MWs will be installed in Lot 8 and Parcel A following development of the Site.

This well installation SOP addresses the following items:

- Pre-drilling activities
- AW and MW well design
- Well installation procedures
- Well destruction procedures

2. PRE-DRILLING ACTIVITIES

The pre-drilling activities addressed in this section include: permits, well location selection and marking, utility clearance, equipment assembly, field documentation, and construction methods documentation.

2.1 Well Permits

Los Angeles County Department of Health Services (LACDHS) requires permits for the injection and monitoring wells. These permits must be obtained for all wells installed at the Site. Upon receipt of the Well Installation Permits, LACDHS requires at least 48-hours notification prior to well installation. Installation of the AWs and MWs should not proceed until approval (written or verbal) has been obtained from the LACDHS.

2.2 Pre-field Documentation and Checklists

The following documents and checklists will be prepared and maintained on-Site during the field activities:

- Site-specific Health and Safety Plan;
- Pre-field Checklist;
- Incident reporting Procedures; and
- Standard Operations Checklist and Dash Card.

2.3 Project Team Kick-off Meetings

Prior to the initial mobilization to the field, a project team kick-off meeting will be held to review the scope of work and the Well Installation Implementation Plan. Attendees to this pre-field kick-off meeting will include Haley and Aldrich's Project Manager and Task Leader, the driller's Project Manager, and the Boeing Project Manager. The kick-off meeting will also discuss and clarify the rolls and responsibilities of project team members during the well installation program, and discuss the schedule of events during the field program. If any changes to the scope or SOPs to be used during the well installation program are identified during the pre-field kick-off meeting, the Implementation Plan and appropriate SOPs will be revised.

One the first day of field work for each of the five phases of the well installation program, a field kick-off meeting will be conducted at the Site. Attendees will include at a minimum Haley and Aldrich's Task Manager, Field Coordinator/Supervising Geologist, Health and Safety Coordinator, and the Oversight Geologist(s), the driller's Task Leader, and the Boeing Project Manager.

2.4 Well Locations and Marking

The locations of the proposed AWs and MWs are shown on Figure 2 of the Implementation Plan. The locations of the AWs and MWs are based on the California Regional Water Quality control Board – Los Angeles Region (LARWQCB) approved locations presented in the work plan for the groundwater remediation pilot study (Arcadis, 2002). The installation phase and well construction details of each well to be installed are presented in Table II of the Implementation Plan. Prior to each phase of the well installation activities, a surveying subcontractor will survey the locations of each of the AWs or MWs to be installed during that phase of work. Locations are to be marked with wood stakes and flagging.

2.5 Utility Clearance

After the well boring locations have been marked, each location will be assessed as to the potential presence of subsurface utilities or known obstructions. The task manager or his/her delegate should identify alternate well boring locations in the event that utilities or other subsurface obstructions are present at the pre-selected locations. In addition, Underground Service Alert (USA) will be notified prior to the advancement of any boring on-site (USA requires at least a 3 business-days notice). Because of on-going development, well locations in Parcel A and the southern portion of Lot 8 along Knox Street will also be cleared for subsurface utilities by a geophysical locator subcontractor and hand augered to a depth of 5 ft below ground surface (bgs) prior to drilling. The remaining well locations in Lot 8 do not require hand auger clearance.

The seven proposed monitoring wells will be installed during Phase V of the installation program, following complete development of the Site. To protect newly installed utilities, each MW location will be cleared by the geophysical locator subcontractor, USA, and will also be hand augered to a depth of 10 ft bgs in a triangular pattern surrounding the well location.

2.6 Concrete Cutting

Some well boring locations may require concrete/asphalt cutting to gain access to the underlying soil. If necessary, well locations will typically require a 2-foot by 2-foot area of asphalt or concrete to be removed to provide sufficient space for the installation of a monitoring well or wells and completion of the well box or protective casing.

2.7 Instrument Calibration and Equipment Organization

Prior to drilling, field equipment will be checked for possible malfunctions, cleaned, and

calibrated. Instruments to be used during well installation and development include:

- Photo Ionization Detector (PID) for work area air monitoring and headspace analysis of soil cuttings;
- Electronic water level sounder;
- Water quality parameters (e.g., pH, electroconductivity, temperature, turbidity and dissolved oxygen) for monitoring purge water quality during well development; and
- Pressure transducers to monitor groundwater levels during development pumping and injection testing.

Calibration procedures provided by the manufacturers should be followed for each instrument. Calibration verification will be performed in the field prior to initial instrument use, at least once a day, or when any indication of instrument malfunction is observed. Oversight geologists are responsible for documenting the calibration verification readings and associated notes for each day that the instruments are used. This information may be recorded in the field activity logbook or on the approximate field instrument calibration log.

Following the maintenance and calibration of all field instruments, the equipment and materials necessary to support the monitoring well installation task will be assembled.

2.8 Field Documentation

A bound field activity logbook will be maintained to document field activities associated with the installation of AWs and MWs. Well construction and development details will be logged (along with any other comments that will aid in the ability to reconstruct the drilling activities without reliance on memory) on the monitoring well construction diagrams (Appendix A – Field Forms) and the field activities logbook. Entries will be made in waterproof black ink. In the case of an error, corrections will be made by crossing a single line through the incorrect information and entering the correct information. All corrections will be initialed and dated.

The following information will be recorded during well installation:

- Drilling contractor's name;
- Drilling method;

- Date of installation;
- Depth of borehole;
- Name of oversight geologist;
- Well number and location with measurements to nearby landmarks;
- Site name and project number;
- Types of construction material and quantity of material (screen type and length, volumes of filter pack, bentonite chips and cement/bentonite grout, mixture of grout, etc.);
- Methods of placement of filter pack, bentonite seal, and annular Portland cement/bentonite seal;
- Static water level after well installation;
- Total depth of well after installation and description of bottom (i.e., hard, soft, etc.);
- Location and description of survey measuring point on well casing;
- Description of fluids added during installation (composition, source, and volume).

All geologic logs, well construction and well development record forms will be provided to the Boeing Technical Manager every two days for review. Geologic description and well construction details will also be included in an electronic object log and uploaded to the Boeing EDMS. A complete set of all field activity logs and field forms will be transmitted on CD to the Boeing Project Manager upon completion of each phase of work.

3. AMENDMENT WELL AND MONITORING WELL DESIGN

The AWs and MWs have similar designs and installation procedures. The designs for the B-Sand and C-Sand AW and MWs are described in Sections 2.1 and 2.2, respectively. The procedures to be used during installation of the AWs and MWs are described in Section 2.3

3.1 B-Sand Amendment Wells and Monitoring Wells

The typical well diagrams of the B-Sand AWs and MWs are shown on Figures 4 and 5 of the Implementation Plan, respectively. A total of 110 AWs and three MWs will be installed in the B-Sand. The B-Sand water bearing unit AWs and MWs will be constructed to the following design:

- Total depth of approximately 85 ft bgs (Depth to be confirmed through the Phase I geologic reconnaissance program);
- Boring to be drilled using hollow stem auger drill rig with 8-inch outside diameter by 5 ft long augers;
- The well casing will consist of 2-inch diameter, poly vinyl chloride (PVC) well casing and screen;
- The screen of the AWs will consist of approximately 20 ft of screen with 0.020-inch machine cut slots. The screen of the MWs will consist of 15 ft of screen with 0.010-inch machine cut slots.
- The screened interval for the AWs will be placed opposite the VOC-impacted water-bearing sand encountered from approximately 65 ft to 85 ft bgs (70 ft to 85 ft bgs for the MWs). However, the actual depth will be confirmed or refined following evaluation of the geologic reconnaissance AW installation described in Section 2 of the Implementation Plan.
- The filter pack material to be used for the AWs will be No. 3 Monterey sand, or equivalent. The filter pack of the MWs will be No. 2/12 sand, or equivalent. The filter pack material may be altered following review of sieve analysis reports of soil samples collected during the Phase I geologic reconnaissance program.
- The filter pack will be installed from total depth to 1 ft above the top of the screened interval. The method of placement and settlement of the filter pack is described in Section 2.3;
- The bentonite seal is to consist of 5 ft of ¼-inch WYO-BEN pellets placed in 12-inch maximum lifts. A minimum of 2.5 ft of the bentonite chip seal must be installed below the static water table to ensure constant hydration of the seal. The method of placement and hydration of the bentonite seal is

described in Section 2.3;

- The remaining annular seal will consist of a Portland cement grout with approximately 4 percent bentonite powder added by weight. The mixture and procedure for placement of the annular seal is described in Section 2.3.
- The level of the grout seal in each well will be periodically inspected for one week following installation to observe any settling of the grout. If settlement is observed, additional grout will be mixed and added to bring it within 3 ft of grade. Any soil which caves into the borehole will be removed prior to placement of additional grout.
- For AWs installed outside of the pad for the planned building, a minimum of 2 ft of stickup of the well casing will remain above grade. The well will be capped with a PVC slip cap and marked with wooden stakes or steel rebar and flagging. AWs located within the future building pad will be cutoff a minimum of 3 ft bgs, capped and the boring backfilled to grade with sand to protect the wells during future grading activities.
- The surface completion of the MWs will consist of a 12-inch diameter traffic rated well box set in concrete with the top of the box raised approximately ½-inch above the surrounding pavement to promote drainage away from the MW.

3.2 C-Sand Amendment Wells and Monitoring Wells

The typical well diagrams of the C-Sand AWs and MWs are shown on Figures 4 and 5 of the Implementation Plan, respectively. A total of 56 AWs and four MWs will be installed in the C-Sand. The C-Sand water bearing unit AWs and MWs will be constructed to the following design:

- Total depth of approximately 115 ft bgs;
- Boring to be drilled using hollow stem auger drill rig with 8-inch outside diameter by 5 ft long augers;
- The well casing will consist of 2-inch diameter, poly vinyl chloride (PVC) well casing and screen;
- The screen of the AWs will consist of approximately 20 ft of screen with 0.020-inch machine cut slots. The screen of the MWs will consist of 20 ft of screen with 0.010-inch machine cut slots.
- The screened interval will be placed opposite the C-Sand water-bearing sand encountered from approximately 95 ft to 115 ft bgs. However, the actual depth will be confirmed or refined following evaluation of the geologic reconnaissance AW installation described in Section 2 of the Implementation Plan.

- The filter pack material to be used for the AWs will be No. 3 Monterey sand, or equivalent. The filter pack of the MWs will be No. 2/12 sand, or equivalent. The filter pack material may be altered following review of sieve analysis reports of soil samples collected during the Phase I geologic reconnaissance program.
- The filter pack will be installed from total depth to 1 ft above the top of the screened interval. The method of placement and settlement of the filter pack is described in Section 2.3;
- The bentonite seal is to consist of 5 ft of ¼-inch WYO-BEN pellets placed in 12-inch maximum lifts. The method of placement and hydration of the bentonite seal is described in Section 2.3;
- The remaining annular seal will consist of a Portland cement grout with approximately 4 percent bentonite powder added by weight. The grout will extend from the top of the bentonite seal to within 3 ft of current grade for the AWs. For the MWs, the grout will be placed to within 2 ft of current grade. The grout mixture and procedure for placement of the annular seal is described in Section 2.3.
- The level of the grout seal in each well will be periodically inspected for one week following installation to observe any settling of the grout. If settlement is observed, additional grout will be mixed and added to bring it within 3 ft of grade. Any soil which caves into the borehole will be removed prior to placement of additional grout.
- For AWs installed outside of the pad for the planned building, a minimum of 2 ft of stickup of the well casing will remain above grade. The well will be capped with a PVC slip cap and marked with wooden stakes and flagging. AWs located within the future building pad will be cutoff a minimum of 3 ft bgs, capped and the boring backfilled to grade with sand to protect the wells during future grading activities.
- The surface completion of the MWs will consist of a 12-inch diameter traffic rated well box set in concrete from 2 ft bgs to the pavement surface. The top of the box will be raised approximately ½-inch above the surrounding pavement to promote drainage away from the MW.

4. WELL INSTALLATION PROCEDURES

The following procedures are to be used during installation of the AWs and MWs at the Site.

1. Refer to Section 2 of the Implementation Plan for the details regarding the collection of continuous cores from the 18 AWs installed as part of the Phase I geologic reconnaissance program. This information will be used to determine the completion depths, well screen intervals, and filter pack specification for the remaining 148 AWs and seven MWs. The 148 remaining AWs are to be drilled without the collection of soil samples for geologic logging. During drilling of the seven MWs, soil samples will be collected for geologic logging at 5 ft intervals using a split-spoon sampler equipped with a sand catcher device but not internal sample rings.

2. Prior to installation, the PVC casing and screen will be decontaminated (if not pre-wrapped. Decontamination of the materials may also be done by high pressure steam cleaning. All personnel handling the decontaminated well materials should wear clean disposable PVC gloves to ensure that the material does not become contaminated prior to installation.

3. After decontamination of all down-hole drilling equipment, the well boring will advanced to the desired well depth. The lead auger/bit used for reaming the boreholes that are not continuously cored will be fitted with a clean wooden plug to maintain a soil-free annulus during reaming.

4. A weighted tape-measure will be used to verify the depth to the bottom of the boring before and after knocking out the wooden plug. The wooden plug is then knocked out with the drill stem rods and 140-pound hammer.

   Note: In cases where heaving sands are encountered, clean potable water may be added to the borehole through the auger to displace the material during installation. The pressure created will keep the casing from moving upward in the augers. During Phase I and possibly Phase II, potable water will be available at the soil vapor extraction compound. For future phases of work, potable water may be obtained from the fire hydrants in Knox Street under permit with the City of Los Angeles. Under no circumstances shall the fire hydrants on the commercial property located south of Knox Street be used due to their connection to an alarm system.

5. When the appropriate depth has been achieved, PVC well screen and casing will be assembled and lowered through the hollow-stem augers. Unless wrapped with plastic from the manufacturer, the well casing and screen for the MWs will be decontaminated before being placed in the borehole. Decontamination of the well casing and screen for the AWs is not required.

6. Once the screen and casing are in place, the sand pack material is poured slowly through the annulus between the interior of the hollow-stem augers and the well casing. The filter pack material to be used for the AWs will be No. 3 Monterey sand, or equivalent. The filter pack of the MWs will be No. 2/12 sand, or equivalent. The filter pack specifications may be altered based on the results of sieve analyses of soil samples collected during the Phase I geological reconnaissance well installation program. The augers can be withdrawn during the placement of the filter pack sand, but the tip of the augers must remain below the top of the filter pack throughout the process to prevent caving of formation material into the annulus between the borehole and the well screen. Following placement of the filter pack to a level of 1 ft above the top of the screen, the well will be surged for approximately 10 minutes with a vented surge block to settle the filter pack. The level of the filter pack will then be measured and additional filter pack material added, if necessary, to bring the level a minimum of 1 ft above the top of the screen. The well will then be surged for an additional 5 minutes and the filter pack level again measured. This process will continue until no further settlement of the filter pack greater than 0.05 ft is measured.

7. The final depth to the sand pack will be recorded on the monitoring well construction form (Figure 1-1). In addition, the volume of sand used for the gravel pack should be recorded in the field activity logbook.

8. The bentonite seal is to consist of 5 ft layer of ¼-inch WYO-BEN pellets placed in 12-inch maximum lifts. The thickness, hydration, and placement of the bentonite seal are critical to seal-off adjacent water bearing zones. To insure constant hydration of the bentonite pellets in the B-Sand AWs and MWs, a minimum of 2.5 ft of the bentonite seal must be installed below the static water table depth/elevation as verified in adjacent MWs or AWs. The screen interval of the C-Sand wells is sufficiently deep enough to ensure constant hydration of the bentonite seal. Following placement of each bentonite pellet lift, a capped tremie pipe will be used to tamp the pellets in-place and the lift allowed to hydrate for up to 10 minutes before the next lift is placed. Prior to placing the next lift, it will be confirmed that there is a minimum of 2 ft of water above the top of the previous lift. If necessary, additional potable water will be added to the annulus to allow hydration of the next bentonite pellet lift. This placement method will be repeated until the entire 5 ft bentonite seal is placed. As the bentonite seal bentonite seal is placed, the augers can be withdrawn. However, to prevent the formation material from caving around the well screen and casing, at no time shall the base of the augers be allowed to rise above the top of the placed bentonite seal level.

9. The final depth to the bentonite seal and seal thickness will be recorded on the monitoring well construction form. In addition, the volume of bentonite used for the seal should be recorded in the field activity logbook and compared to the calculated volume in the field to verify adequate seal placement.

10. The remaining annular seal will consist of a Portland cement grout with approximately 4 percent bentonite powder added by weight. The mixture will consist of the following; 94 pound bag of Portland Type I/II cement, 4 pounds of bentonite powder, and approximately 8 to 9 gallons of potable water. The bentonite powder and water shall be mixed first and the cement added after it has mixed. The cement and bentonite powder must be loose and free of lumps. The grout will be mixed immediately prior to placement in each individual well. Because of the small annular space between the well casing and the inner wall of the hollow stem auger, a tremie pipe of 1-inch diameter must be used. Because of this small diameter tremie pipe, the grout mixture must have a density between 14.5 and 15.0 pounds per gallon and be fully mixed. The oversight geologist must approve the mix and consistency of each grout mix used using a 1/2-gallon container and a weight scale. The grout will be placed from above the bentonite seal to within 3.5 ft of ground surface using a temporary tremie pipe with the bottom of the pipe placed within 2 ft of the bentonite seal. Grout shall be tremied into the auger annular space as the augers are withdrawn. A minimum of 2 ft of grout shall be maintained in the base of the augers at all times as they are withdrawn. The tremie pipe can be withdrawn during the grouting process, but the tip of the pipe and augers must remain below the top of the grout throughout the process. The well will be periodically inspected in the days following placement of the grout seal to ensure that no settlement occurs and additional grout added to maintain the level approximately 3.5 feet bgs. Any soil or other debris observed on top of the grout seal will be removed prior to adding additional grout, if necessary.

11. For AWs installed outside of the pad for the planned building, a minimum of 2 ft of stickup of the well casing will remain above grade. The well will be capped with a PVC slip cap and marked with wooden stakes and flagging. AWs located within the future building pad will be cutoff a minimum of 3 ft bgs, capped and the boring backfilled to grade with sand to protect the wells during future grading activities.

12. The surface completion of the seven monitoring wells will be a 12-inch diameter traffic rated well box set in concrete. The top level of the well box will be raised approximately ½-inch above the pavement level to promote drainage away from the box.

13. Record the applicable geologic and well construction data in the electronic object log and upload the log to the Boeing EDMS.

5. WELL DESTRUCTION PROCEDURES

The purpose of this section is to present the procedures required for the destruction of an AW if well development or water injection testing (WIT) (See Appendix D of the Implementation Plan) indicates that the AW does not have good hydraulic connection to the target water bearing unit (i.e., B-Sand or C-Sand) and can not be used for the addition of amendment.

5.1 Destruction Activities

The well destruction activities addressed in this section include: permits, review of existing well information, equipment assembly, field documentation, and well destruction methods.

5.1.1 Required Permits

LACDHS requires permits for well destruction. LACDHS well destruction permits will require at least 7 working days for the approval process. Well destruction should not proceed until written or verbal approval has been obtained from the LACDHS.

5.1.2 Preliminary Well Review

Prior to initiating the well destruction activities, the Field Coordinator/Supervising Geologist or Task Manager will review all relative information regarding the details of construction and the relative soil and groundwater data associated with the well to be destroyed. The site geologist will inspect the well location for access or obstructions such as equipment storage or materials placement on top of or near the well cover.

5.1.3 Concrete Cutting

Prior to well destruction, the concrete and asphalt surrounding the existing well (if present) will be cut and removed. Enough concrete should be removed to provide sufficient space for the well destruction procedure.

5.1.4 Instrument Calibration and Equipment Organization

Prior to drilling, field equipment will be checked for possible malfunctions and calibrated according to procedures provided by the manufacturer. Field instrument calibration verification will be performed in the field prior to their initial use at least once a day, or when any indication of instrument malfunction is observed. This information may be recorded in the field activity logbook or on the appropriate field meter calibration log.

Following the maintenance and calibration of all field instruments, the equipment and materials necessary to support the well destruction task will be assembled.

5.2 Field Documentation

A field activities log book will be maintained for all field activities associated with the destruction of a well. Entries will be made in waterproof black ink. In the case of an error, corrections will be made by crossing a single line through the incorrect information and entering the correct information. All corrections will be initialed and dated.

The following information will be recorded for each well destroyed:

- Drilling contractor
- Name of field person(s)
- Well number and location
- Well depth and static water level
- Well destruction equipment and method employed
- Date and time of well destruction
- Type and volume of sealant material (volume should be consistent with the anticipated borehole volume)

5.3 Well Destruction Methods

Wells will be destroyed by over-drilling and removal using a hollow-stem auger drilling methods, or LACDHS and Boeing Project Team approved alternate drilling/destruction methods.

The procedures for destroying a well are as follows:

1. Once the surrounding asphalt and concrete (if present) has been removed, the existing well cover and well box (if present) can be removed.

2. Set up the drill rig over the well to be destoyed. With a hollow-stem auger (10-inch minimum diameter), over-drill the existing cement/bentonite seal and sand pack along the entire length of the well.

3. Advance the auger drill string to the desired removal depth (total depth). With the hollow-stem in place, pull the existing well casing through the open augers using the wire-line winch attached to the drill rig. Containerize the well waste materials as described Section 1.4 of this exhibit.

4. Prepare the bentonite-cement grout (sealing material) using the following mixture:

- One 94-pound sack of Portland Type I/II cement
- Approximately 3 to 5 pounds of powdered bentonite
- 6.5 gallons of clean potable water
- The density of the grout mixture should range from 15.6 to 16.2 pounds per gallon and must be verified by the oversight geologist using a calibrated container and weight scale.

NOTE: An alternate approved mixture may be used in place of the bentonite-cement grout mixture above if the alternate mixture complies with the California water well standards.

5. Backfill the vacated boring annulus with a bentonite-cement grout by tremie pipe methods, to prevent the grout from free-falling or becoming diluted or separated during installation. Retract the hollow-stem augers from the borehole at the same rate that the grout is being pumped to prevent the borehole from caving in prior to placement of the sealing material. The grout should be added to the borehole at a speed that will keep the groundwater from rising to the surface and flooding the area around the borehole.

   NOTE: The volume of grout used to seal the borehole should be greater than the calculated volume of the total depth of the borehole.

6. Fill the remaining borehole annulus to approximately 1 ft below the ground or pavement surface with the grout mixture. Record the volume of grout used to seal the borehole.

7. Decontaminate all drilling equipment using a high pressure washer and steam cleaner, or by hand washing with and Alconox solution and two tap water rinses.

8. Contain all soil cuttings, solid wastes, and any displaced groundwater in 55-gallon drums. Seal each drum with a drum lid. Label drums according to the Waste Handling section (Section 3.3) in the Implementation Plan.

9. Place all trash (i.e., spent gloves, paper towels, plastic sheeting, etc.) in plastic garbage bags and dispose of properly.

APPENDIX D

Well Development and Testing Standard Operating Procedures

WELL DEVELOPMENT AND WATER INJECTION TESTING STANDARD OPERATING PROCEDURES FOR LOT 8 – PARCEL C GROUNDWATER REMEDIATION WELL INSTALLATION PROGRAM FORMER BOEING C-6 FACILITY LOS ANGELES, CALIFORNIA

by:

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San Diego, California

for:

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Long Beach, California

File No. 28882-604
16 August 2004

HALEY& ALDRICH

1. INTRODUCTION

The purpose of this document is to present the standard operating procedures (SOPs) required for development of the 166 bioremediation amendment wells (AW) and seven groundwater monitoring wells (MWs) in Lot 8 – Parcel C of the former Boeing C-6 facility (Site) in Los Angeles, California. The wells are to be installed as part of the groundwater remediation program for the Site. This document also presents the SOPs to be used for water injection testing if an AW displays low recharge during well development. The development and water injection testing will be overseen by a geologist who will be responsible for ensuring that these standard operating procedures (SOP) are followed.

1.1 Objectives

All newly installed AWs and MWs will be developed prior to use but after the surface seals have been allowed to set for a minimum of 72 hours following well completion. The purposes of well development are to;

- Remove fine-grained formation material from the well which may have entered the well screen during installation;
- Clear fine-grained sediment from the well screen openings to increase hydraulic communication with the filter pack;
- Wash fine grain sediment from the filter pack and increase hydraulic communication with the formation of the water bearing unit; and
- Restore the groundwater properties disturbed during the well installation process.

Removal of fines from the AWs is particularly important, as any fine-grained formation materials could be forced into the formation during amendment injection activities and could inhibit flow and reduce well efficiency.

If any AW displays slow recharge rates during development, a water injection test (WIT) will be performed. The primary purpose of this test is to evaluate the competency of the AW for use as an amendment well. The WIT will also provide hydraulic data that will be used to better plan injection activities.

2. WELL DEVELOPMENT SOP

Development of wells consists of initial development (pre-development) during construction of the well, to settle the filter pack, and development of the well a minimum of 72 hours following placement of the surface seal to wash the well screen and increase hydraulic communication with the formation of the water bearing units. The SOPs for these tasks are described below.

2.1 Pre-Development

Initial development of the AWs and MWs (pre-development) will be performed during emplacement of the well filter pack to ensure that the filter pack has settled. This pre-development procedure is covered in the Well Construction and Destruction SOP (Appendix C, Section 4), but is included here for completeness and cross-reference. Once the well screen and casing are in place, the filter pack material is poured slowly through the annulus between the interior of the hollow-stem augers and the well casing. The filter pack material to be used for the AWs will be No. 3 Monterey sand, or equivalent. The filter pack of the MWs will be No. 2/12 sand, or equivalent. The augers can be withdrawn during the placement of the filter pack sand, but the tip of the augers must remain below the top of the filter pack throughout the process to prevent caving of formation material into the annulus between the borehole and the well screen. Following placement of the filter pack to a level of 1 ft above the top of the screen, the well will be surged for approximately 10 minutes with a vented surge block to settle the filter pack. The level of the filter pack will then be measured and additional filter pack material added, if necessary, to bring the level a minimum of 1 ft above the top of the screen. The well will then be surged for an additional 5 minutes and the filter pack level again measured. This process will continue until no further settlement of the filter pack greater than 0.05 ft is measured.

2.2 Well Development

This section presents the equipment and procedures to be used during well development.

2.2.1 Equipment

The equipment to be used during well development includes the following:

- Well development rig equipped with boom, winch, submersible pump, electric generator, and high pressure washer and steam cleaner;
- 2-inch diameter vented rubber surge block;
- 1.5-inch diameter steel bailer;
- 2-inch diameter submersible electric pump (e.g., Grunfos Redi-Flo 2) with electric cable, steel retaining cable, and Nalgene or Teflon discharge hose;
- Calibrated container and stop watch to measure pump discharge rate;
- 1-liter Imhoff Cone;
- Electronic water level sounder with 0.01 ft increments;
- Level pressure transducer connected to surface data logger with data cable;
- Water quality meters for monitoring pH, electroconductivity, turbidity, temperature, and dissolved oxygen

- Water Development Record form (included in Appendix A of the Implementation Plan)

2.2.2 Well Development Procedures

Prior to development, total depth, the feel of the bottom of the well (i.e., soft or hard bottom), and the static water level in the well will be measured and recorded in the Well Development Record form. A copy of the Well Development Record form is included in Appendix A – Field Forms of the Implementation Plan.

The volume of water contained in the well casing (casing volume) will be calculated using the well diameter, total depth, and the static depth of water measured prior to the start of development activities. The casing column conversion factor for 2-inch inside diameter (ID) schedule 40 Poly vinyl chloride (PVC) well casing is 0.175 gallons per linear foot of casing. Well development will then proceed following the steps below.

1) Wells will first be bailed of any accumulated sediment in the bottom of the well using a steel bailer to remove as much sediment as possible. The bailing time duration, total depth of the well, and volume of water and sediment removed at the end of bailing will be estimated and noted on the Well Development Record.
2) Wells will then be surged using a 2-inch diameter, vented rubber surge block for a period of no less than 1 minute for every linear foot of well screen (a minimum of 20 minutes for a 20 ft length of well screen) to wash water in and out of the well screen through the slotted openings. The surge time duration and total depth of the well will again be measured and recorded on the Well Development Record.
3) The well will again be bailed of any accumulated sediment. The suspended sediment load should be monitored during bailing using a 1-liter Imhoff Cone. Bailing of sediment should be performed until the sediment load decreases to a point that a submersible pump can be used. This point is typically when less than ½- to 1-inch of sediment settles in the bottom of a 1-liter Imhoff Cone. The bailing duration, well total depth, and the volume of water and sediment bailed from the well should again be measured and recorded in the Well Development Record.
4) An electric submersible pump and a water level pressure transducer with data wire leading to the surface will then be inserted into the well and lowered to the pumping depth approximately 2 ft above the base of the well. The transducer's data wire will be connected to a laptop computer for monitoring the water levels during the pumping phase of development. The pre-pumping water level will be measured with an electronic sounder and level transducer activated with water level data recorded every 30 seconds. The simultaneous measurement of the sounder's depth to water level and the transducer's level (height of water column above transducer) reading should be recorded together on the Well Development Record.
5) The submersible pump should be started and adjusted to an initial pumping rate of approximately 2 gallons per minute (gpm). The well should be pumped at 2 gpm for a minimum of 10 minutes to remove suspended sediment. The water level in the well should be monitored with the level transducer data. Every 5 minutes during pumping,

the sediment loading in the discharge water should be monitored with Imhoff Cone and the water quality parameters (i.e., pH, temperature, electroconductivity, turbidity, and dissolved oxygen) monitored with field instruments and recorded in the Well Development Record. The volume of water pumped and the stabilization of the water level at the end of the initial pumping at 2 gpm should also be recorded.

6) If after 10 minutes of pumping at 2 gpm the sediment load in the discharge water remains high (i.e., greater than the sediment loading goal of ¼- to ½-inch of sediment in the base of the Imhoff Cone), the 2 gpm pumping rate should be maintained until the sediment load decreases to less than ¼- to ½-inch in the Imhoff Cone). After the sediment loading goal is reached at the 2 gpm rate, the pumping rate should be increased to approximately 5 gpm for a period of 10 minutes, and the above described monitoring performed.

7) After 10 minutes or if the sediment loading goal is reached (which ever is longer), the discharge rate should be increase to the maximum pumping rate of the pump and the well pumped at this rate until the sediment loading goal is reached. Given the depth of the wells to be developed, 8 gpm is probably the maximum pumping rate possible with the development pump.

8) If the water level in the well drops to the pump intake during pumping, the pumping rate should be decreased until a sustained pumping rate is achieved. The well should be pumped at this sustained rate until the sediment loading goal and the water quality parameters stabilize to within 10 percent of previous readings.

9) If the sediment loading does not decrease to less than ¼- to ½-inch of sediment in the Imhoff Cone within 2 hours of total pumping time, the pump and level transducer should be removed and the well surged for 10 minutes and bailed again to wash fine-grained sediment from the well screen and filter pack, and the pumping process resumed. If the sediment loading goal is not reached with 1 hour of this second pumping phase, the pump should be turned off, but remain in the well with the transducer, and the water level recovery monitored with the level transducer until 80 percent of the static water level is recorded, or 30-minutes, which ever is less. The 80 percent recovery is defined as 80 percent of the distance between the initial static water level and the pumping level measured at the end of the pumping stage. Following this recovery stage, the pump and level transducer can then be removed from the well. The development results should then be evaluated by the Project Team to assess if further development is required or if the well should be identified as unacceptable. If filter pack material is observed in the bailed sediment, video camera logging of the well may be performed to assess the source of the filter pack (e.g., cracked well screen).

10) Once the pump and level transducer are removed from the well, the total depth of the well should be measured and the conditions in the bottom (i.e., hard or soft bottom) of the well recorded in the Well Development Record. This measurement shall be repeated the following day to allow any sediment to settle to the base of the well. If sediment is detected in the base of the well following pump removal or the following day, the well may have to be bailed (with a clean bailer) to remove this sediment.

This sediment may have been washed from the well screen but did not enter the pump intake during the pumping stage and settled in the base of the well.

11) If the sediment loading goal is reached within the 3 hours of total pumping time, the pump should be turned off and the water level recovery monitored as described above until 80 percent of the static level is achieved, or ½-hour of recovery time is measured. The time to achieve 80 percent (or more) recovery should be noted in the Well Development Record.

12) The level transducer data should be saved on the computer with a filename with the AW identification number and date (e.g., filename "AW0022C Devdata 082704.xls") for download and possible further analysis.

13) For MWs, once the sediment loading goal is achieved and the water quality parameters stabilize to within 10 percent of previous readings, development of the MW is considered complete.

14) If an AW takes longer than ½-hour to achieve 80 percent of static water level recovery, the AW should be flagged as a "Slow Recharge Well" and a Water Injection Test (WIT) performed following the WIT SOPs presented in the following section.

15) Following well development, all used equipment (i.e., surge block, bailer, winch cable, pump, electronic sounder, level transducer and data cable, and the water quality meters) should be decontaminated between each well by use of a high pressure washer and steam cleaner, or hand washing with an Alconox solution and a double tap water rinse followed with a distilled water final rinse.

2.2.3 Waste Management

Storage and disposal of the investigation derived wastes (IDW) generated during the well development program will be coordinated with the Boeing Waste Management Specialist Ms. Marcia Taleff a minimum of 2-weeks prior to mobilization for each phase of the program.

Where possible, bailed sediment will be separated from well development water and placed in roll-off bins to be located in a designated waste handling area on the Site. The driller will transport the separated sediment from the well location to the roll-off bins using a soil hopper and a forklift.

Well development water and decontamination rinse water will be placed in a 6,000 gallon holding tank located in a designated waste handling area on the Site. The driller will be responsible for pumping all decon rinse water and well development water into the holding tank.

All debris and trash will be collected and disposed of daily by the driller.

All IDW containers will be labeled with an adhesive waterproof label and waterproof marker and catalogued on a daily basis. Each container label will contain the following information:

- Client (generator) identification (name and address);

- Name and phone number of Boeing Waste Management Specialist;
- Date(s) generated;
- Container Contents (example: well cuttings from well AW-112, development purge water from wells AW-97 and AW-98, etc);
- Estimated volume or capacity; and
- Physical state of material (solid or liquid)

The Field Coordinator will be responsible for maintaining a compiled list of all of the IDW containers generated on a daily basis. A waste inventory form is included in Appendix A. This list is to be provided to the Boeing Waste Management Specialist every Friday during the drilling program.

3. AMENDMENT WELL WATER INJECTION TEST SOP

The evaluation of AWs for acceptance will follow the Well Construction Plan flow Chart (Figure 3 of Implementation Plan). During the AW development process described in the proceeding section, AWs will be evaluated as to their recharge capability. If an AW requires more than ½-hour to achieve 80 percent recovery of the static water level once the pumping stage is completed, the AW will be flagged as a "Slow Recharge Well" and a water injection test (WIT) performed. The equipment and SOPs required for the WIT are described below.

3.1 Equipment

The equipment required for the proposed WIT includes the following:

- 500 gallon holding tank with bottom drain fitting and filled with potable tap water mounted on trailer or flatbed truck;
- Electric pump connected between holding tank's bottom drain fitting and manifold capable of pumping up to 30 gpm at a minimum of 25 psi;
- In lieu of use of the holding tank and pump, it may be possible to use long lengths of fire hose and the fire hydrants on Knox Street to provide the water for the WIT;
- Two 25 ft lengths of 1-inch diameter hose with appropriate connections to the pump discharge, the valve manifold, and a 2-inch slip-fit coupling for attachment to the AW wellhead;
- The water test manifold used by Arcadis G&M, Inc. during the Building 2 Area amendment well testing program.
- One combined pressure transducer/datalogger (e.g., Solinist Levellogger) (rated to a minimum 150 ft head);
- Parts for assembling the well-head fitting (2-inch PVC TEE, 2-inch PVC ball valve, pressure gauge [0 to 10 psi range], and fittings to connect hose as shown in Figure 1);
- Water level sounder with 150 ft length.

The PVC TEE should be securely attached to the AW well-head by cementing a 2-inch PVC male adapter to the well casing with PVC cement for one-time use. A 2-inch PVC female adapter can be cemented to the re-usable PVC TEE so the TEE can be used for WITs on other AW wells. This well-head fitting will provide a seal that will sustain the applied pressure (about 15 psi max) during the WIT.

The 2-inch ball valve on top of the well-head allows use of a water level sounder, allows the well casing to be vented as the well casing fills.

Using a pressure transducer with an aboveground datalogger allows the collection and recording of the height of water in the well casing during the WIT. The electronic data cable for the transducer must have a pressure fitting due to the pressurized well. Because this transducer needs to be able to measure the full range of response, which will be as high as 60 psi (120 ft of water), the Soloinst Levellogger can not be used due to its limited response range. An additional transducer and datalogger can be used for nearby AWs or MWs screened in the same water bearing unit to provide for monitoring of water levels in these wells during the WIT. The water level sounder will be used during the WIT to monitor water levels within the casing of the injection well as well as any adjacent AWs or MWs.

3.2 Water Injection Test Procedures

The WIT will be implemented following the Well Construction Plan Flow Chart (Figure 3 in the Implementation Plan). The AW WIT will evaluate the specific injection capacity of the well (i.e. incrementally fill and maintain the water level in the well casing and monitor the injection rate. If the WIT injection rate is greater than 2 gpm, the AW is acceptable for use during the amendment injection program. If the injection rate is less than 2 gpm, the AW shall be rejected for use as an amendment well.

During the WIT, nearby AWs or MWs, if present may be used to provide additional data on the effect of the injection as a secondary check on the response of the WIT on the AW.

The data collected during the WIT will include the following:

- The water level in the injection well and any adjacent AWs or MWs will be recorded during injection, along with the corresponding injection flow rate (read from the digital flow meter).
- The line pressure and flow rate achieved at the maximum pressure setting will be recorded.
- A volume totalizer will be used to monitor the total volume of water injected into the well over the course of testing.

The field log sheet to be used for data collection is included in the Field Forms in Appendix A of the Implementation Plan.

The Stage I atmospheric water injection test will be conducted without applying excess pressure to the well-head. This will simulate the water injection rate under conditions most likely to be applied during future amendment addition events. The WIT shall be conducted as follows:

1) Prior to the test, a City of Los Angeles Hydrant Meter will be attached directly to the fire hydrant source. Fire hydrant sources may be too far away from the AW being testing. In lieu of a fire hydrant source, a 500 gallon mobile holding tank and electrical pump can

be used. All fittings should be secured before commencing the test. The oversight geologist will document the injection equipment used and the fittings used to connect to the well head. Photographs of the equipment should be taken.

2) Check the calibration of the flow meter in the test apparatus, if this has not already been done beforehand.

3) Measure static water level in the injection well.

4) Measure static water level in the adjacent wells that will be used as observation points. The observation wells should be within 50 feet of the AW being tested. Suspend a pressure transducer (if available) in each of the observation wells. Record the position of each logger.

5) Attach the well-head fitting to the well, suspending a pressure transducer connected to a data logger in the well at the same time. The recording interval for the data logger should be set at 15 second intervals. Since this logger will be exposed to the full range of the injection pressure, it needs to have a minimum full-scale response of 150 ft. The Solonist Levelloggers have a reading range of about 62 ft and should not be used. Record the position of the logger.

6) The test should last approximately 30 minutes, or not more than 500 gallons of injected water. During the test, injection flow rates, water levels (pressures) and total volume of water injected should be recorded on the log sheet provided in Appendix A of the Implementation Plan. Periodic water level measurements should be taken from the adjacent observation wells by hand (if available) to confirm the datalogger results.

7) Set the water level sounder to 15 ft above the static water table level. With the well vent valve open to allow air to escape, initiate flow to the well, beginning with a flow rate of 2 to 3 gpm. Gradually increase the flow rate until the water level in the well has risen to the water level sounder sensor. Maintain this sustained atmospheric injection rate for 5 minutes. Record flow rate and water level. Record the water level in the adjacent observation well(s) (if available).

8) Reposition the water level tape 30 ft above the static water level.

9) Increase the flow rate until the water level in the well has risen to 30 ft above the initial (static) level. Maintain this injection rate for 5 minutes. Record flow rate and water level. Record water level in adjacent monitor well(s) (if available).

10) Reposition the water level tape 45 ft above the static water level.

11) Increase the flow rate until the water level in the well has risen to 45 ft above the initial (static) level. Maintain this injection rate for 5 minutes. Record flow rate and water level. Record water level in adjacent observation wells (if available).

12) Reposition the water level tape to 2 ft below the top of the well-head, about 60 ft above the static water level.

13) Increase the flow rate until the water level in the well has risen to the water level sensor (near ground surface), approximately 60 ft above the initial (static) level. Maintain this injection rate for 5 minutes. Record flow rate and water level. Record water level in adjacent observation wells (if used).

14) Stop water addition. Record times and water levels as the water in the casing falls. The logger should capture this information, so the manual measurements will serve as a check on the data. Record water levels in monitor well(s).

Calculate specific capacity (flow rate/height of water in casing) for the four steady-state height of water in casings and injection rates. If the AW can accept injection of water at rates greater than 2 gpm, the AW is acceptable for use. If the injection rate is less than 2 gpm, the AW can not be used, and the cause of the failure of the AW shall be evaluated. And the well replaced.

Following the WIT, all down hole equipment must be decontaminated by hand washing with an Alconox solution, double rinse with tap water, and a final rinse with distilled water.

Well Testing Record forms will be provided to the Boeing Task Manager for review. Data logger data will be graphed and evaluated to assess the specific injection capacity of the AW and AW acceptance or the requirement to destroy the unacceptable well and re-install the AW according to the Well Construction Plan Flow Chart.